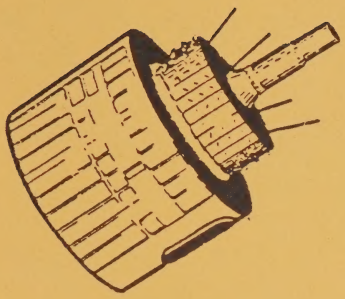
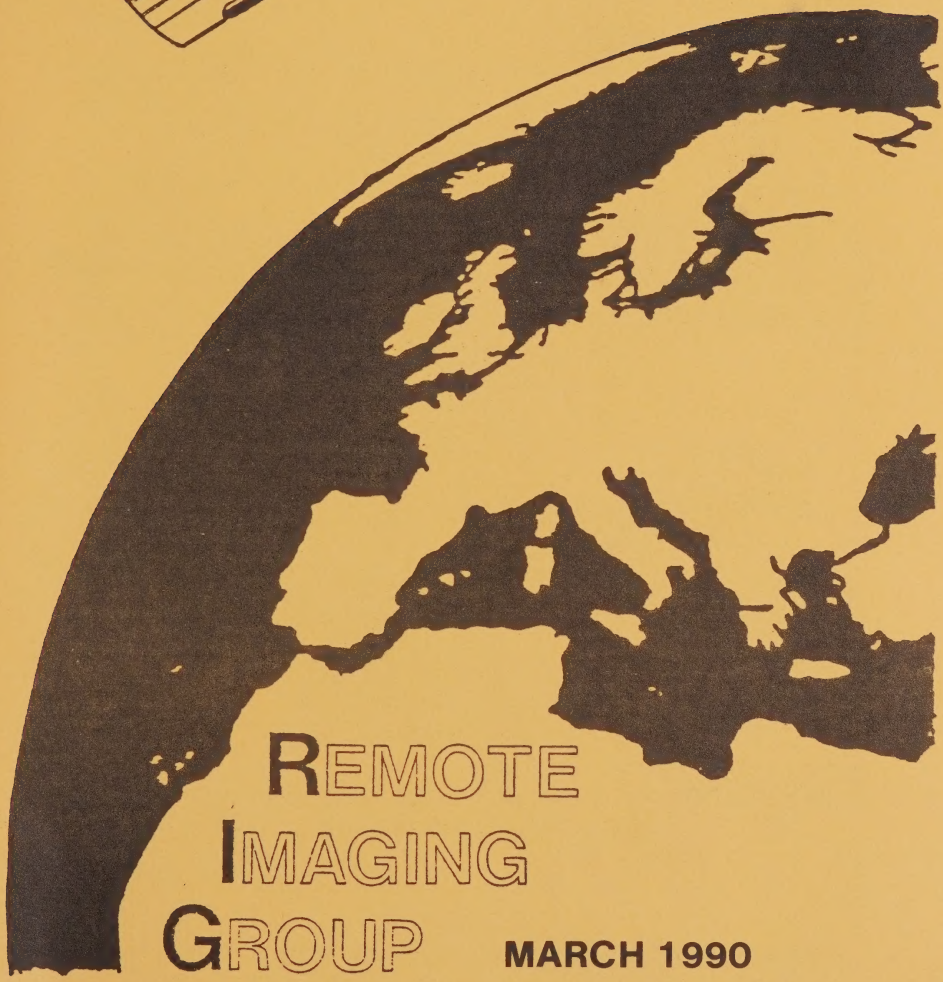
NEWSLETTER No. 20





REMOTE IMAGING GROUP

MARCH 1990

REMOTE IMAGING GROUP (R. I. G.)
NEWSLETTER No. 20 MAR 1990

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Published by the Remote Imaging Group (RIG).
Printed by Meridian Printers Holbeach Spalding Lincs.

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EDITORIAL & SECRETARIES PAGE

This issue marks the completion of 5 years of the RIG as you know it! Prior to this Henry, our chairman produced an issue 0 which was circulated to those early members who signed the 'I am interested book' that Henry, by himself, exhibited on a table together with yards of Muirhead images at a number of amateur radio rallies back in 1985. Issue 0 was produced on a typewriter that didn't have a microprocessor and reproduced on his not so young photocopier and sent out to over 320 addresses. Now we are using word processors, IBM PC clones and Laser printers, Desk Top publishing is around the corner waiting for me to read and understand the manual! The next 5 years will bring Polar platforms, probably more types of digital transmissions and even more powerful computers to process them. My biggest concern is, that with digital transmission comes tremendous scope for encryption, and with companies taking commercial interest in remote imaging, the interests of the amateur may be forgotten.

Anyway on to my problems. The ever increasing pile of mail and the lack of time to finish the new MkII framestore boards continue to be an embarrassment. Members questions are better answered by a 'phonecall for the time being. A new (secondhand) but more powerful computer has arrived and the move to the new machine will be completed after this newsletter has gone to the printers.

Rallies: We attended the Picketts Lock rally for the first time and was judged a reasonable success and we have signed up for next year. We plan to attend the RSGB rally in Birmingham only if we can get a reasonable deal from the RSGB and we can muster the staff needed to run it - so no promises there. The remaining rallies we are attending are: BATC rally at Harlaxton Manor, 6 May, the RSGB VHF convention at Sandown Park Racecourse where we hold our agm, 12 May; Elvaston Castle on 24 June, RSGB Mobile rally at Woburn Abbey in August and a new venue for us, the Leicester Rally at Granby Halls in the Autumn. In addition Henry, single handed, has offered to do the Northern Mobile Rally at the Great Yorkshire showground on the 20th May and the Longleat Rally later in the year. Local RIG members are asked to contact Henry to help him run the stand, he can't do without local RIG member support - please call him.

(Continued on page 68)

Chairman's Waffle

Welcome to the 1990 season of the Remote Imaging Group. From the way the subscription renewals have come in, we must be doing a passable job! In the first four weeks nearly half of you had renewed, and by the time I have finished composing this waffle, I suspect that over threequarters will have done so, which definitely cannot be bad.

I think that I ought to congratulate Ken Willis on his rather dubious honour of being the author of the first article to be included those funny glass things that were fashionable at one time or other. What's more he managed to use two of them when I'm sure that he could have redesigned the circuit to use a double yolked version.

Why hasn't someone come up with a 2400 hz detector circuit to use as a squelch type circuit to control tape recorders etc.? If this was done, it could be the onset of a decline in the audio tape market. There wouldn't be masses of tape that was useless because next door was cutting his lawn or his son was messing about on a motorbike. Setting any squelch type control is a very delicate business, you don't want to miss anything but if you set it too fine all you get is unnecessary tape usage and when the satellite comes round there is none left. So a sensitive 2400 hz detector is needed that can smell it even if you cannot. The result would be only genuine signals on the tape.

In RIG 19 Mr Hayes made a comment about "raking" through the junk box etc. In my Word Processor the Thesaurus gives the following for raking -- collect, gather, amass, heap, pile, take in, -- all of which seem to have a sort of associated meaning but not the correct one. I would add -- sift through, scratch around in. The purpose is simply to find something to use for the job in hand which either costs very little or something closely suited to the project. We don't hoard junk, we might amass quite a quantity of specialist items that we might need one day, but it isn't junk. Needless to say, I can't convince my wife that there is a difference, its all the same --- JUNK.

On the Weather Forecasts on ITV at 5.55pm and other times, had you noticed the piece of string that the Satellite dangled from? Was it provided by Powergen? It must have been real Scientific stuff, until someone cut it -- they changed the intro sequence! Anyway, the time of the last picture shown from Meteosat and the programme transmission time is too long a delay.

The forecast at 5-55pm probably uses the 3.00 pm Meteosat D2 image! A lot has happened since then. They need to tighten up and use more up to date information. I still prefer the animations used on Eurosport ie. a long time span animation, but their last picture is also ages old. It could be speeded up and repeated several times while the voice over is done. With any type of forecast you are usually proved wrong!, I forecast that we would have a "humdinger of a winter" -- Murphy's law -- it was mild, then it was very windy then mild again followed by even more wind and it's only the end of February.

I had the foresight to take the Quad Loop Yagi into the warm just a couple of days before the first high velocity airstream manifested itself. When it started, I was actually tied up on parochial business in the village, (which turned out to be considerably different from that which was expected). Fortunately no real damage was done except to a prefabricated garden shed which hadn't been erected. It changed its location involuntatrally (to me that is) even though it was actually tied to an antiquated shed with good strong rope. It wasn't strong enough and decided to go walkies and got rather battered about. The antiquated shed survived relatively unscathed. Still it was covered by my household insurance, and when I can get the forms filled in, perhaps I can get a replacement. As for the wind itself, I hadn't got a wind speed indicator working but the 12 foot dish needed realigning after rolling around its little patch. The dog kennel even became horizontally polarised but I hasten to add that the dog wasn't in it at the time! The patio door / window was leaking badly and acted as a zoom mirror on my reflected image (with quite a magnification or reduction ratio) all caused by wind pressure. It seemed to spring leaks while I looked at it. So I invited the salesman to come and have a look too, which he did. He thought it was a very exposed location (an understatement) and the cause of my problem was thought to be the extreme wind pressure which forced the water to go upwards in those circumstances!

There were several good articles in VHF Comms 89/4 edition. There were articles about Keplers for the SUN and MOON, Radio Astronomy at VHF and UHF, and further details on Weather Satellite Software for Computers etc. This last article was by Matjaz Vidmar YT3MV (ex YU3UMV), all well worth reading.

Whilst working on my own framestore system I realised that there was no easy way of measuring the signal to noise ratio of the images. If you feed the signal into a framestore and look at the signal on an oscilloscope you cannot see how clean the image is. But if you have a good old Tektronix 545B or later you can use the second timebase system to lock the frame sync to, and then use the A delayed by B system and its ten turn offset pot to look at individual lines. This tells a different tale and because you can go up and down the image you can measure peak white values and black levels (sync or image blanking), but do not include TV line sync as it is generated internally and is not part of the incoming signal, to give total values. The amount of noise (frozen noise) is seen in a section of the image which is supposed to be of the same value. The test card bottom section (sent first) is ideal for this, especially if the image is slipped to give both sides of the sync pulse. A section should be chosen that is a level step in the grey scale, ie. of finite value (don't cheat by limiting). It will have variations in its actual value due to the noise present (unless you are using 10 foot dishes and a GASFET preamp). Some of these variations will be quantitisatation noise but most will be our ever present enemy. Noise value divided by the total value (pk white to black) will give you a figure approaching the real signal to noise measurement. My system gives 6 - 7 percent noise!

How many bulbs did you have to replace in your strings of Christmas Lights this last year? Make it a thing of the past by including a 800v diode of adequate current rating in series with them. A suitable location is in the plug itself. You know all the government health warnings so Be Safe not Sorry! They flicker (twinkle?), but last a lot longer because of the lower power disapation and any remaining problems can usually be traced to loose bulbs.

I was hoping to get the front cover Jazzed up for this issue but alas the spirit was willing but time was lacking. Other similar sized quarterlies have managed to beat us in that respect even having colour pictures on the cover! Well we didn't manage it but I would like to sharpen up a bit in this area. The text could be repositioned etc., but I think the satellite can stay after it has had a coat of paint and been modernised. The main bit that needs rejuvenating is the section of the globe! I wonder what type of projection it is? Don't use it for navigational purposes! Obviously we could do with some help with this, so if you have a talent for this, offers to Phil, there are no prizes but I think that just by using the best design will be reward enough!

The saga of METEOSAT 4 is quite involved and there are many varied official versions of what was really going on! Some undisputed facts remain. MET4 has problems mainly connected with the IR sensor and its associated channel of high resolution imagery. MET3 had been exported to the West but because of legal / contractual reasons could not be utilised. Because of the MET4 problems and the programmed launch (mid Summer but already delayed) of the next in the series, it was thought necessary to send MET3 back to 0 degrees west and be put in operation again. MET4 was then shifted to a position about 7 degrees west so that tests could be done to locate the problem and either correct it or get any modifications done before the next in series is launched. Confusion set in during early January when initially QRM (interference when 2 transmitters are operating on similar frequencies) was visible on the MET4 images. This became worse day by day. When I contacted Weatherwatch at Lasham they said that it was MET2 being checked out before being sent out of geostationary orbit and that it would be cleared in days as soon as they were finished. This may or may not be true but I believe that it was MET3 being drifted onto station. Stations with large antennas would not have seen the problem because of the selectivity of their antennas. Those using Quad Loop Yagi's or even 1 Metre dishes certainly did. It is sometimes possible to reduce this interference by carefully repositioning the antennae. On either side of all antennae's main beam are very sharp nulls. These are used to reduce the strength of the interfering signal. Remember not to align it for maximum on the signal strength meter because this adds the two signals together. Align the antennae for minimum interference and hope that there is enough of the wanted signal. On a 1 metre dish the main beam is say +/- 5 degrees wide at the 3db points. The nulls will probably be about +/- 10 degrees. If the unwanted signal is at say 7 degrees west and the wanted one at 0 degrees, a normally aligned system will have interference from the unwanted signal that is say 6db down on the wanted one. If however the dish is realigned to look further East, at say 3 degrees East, the wanted signal will not be at maximum but only say 1db down whereas the unwanted one will be as much as 20db down in the null, giving a reduction of 19db which is a considerable improvement on the original 6 db. This should be food for thought and an excuse to have a go yourselves. It must be remembered that MET3 is operational and it is MET4 that is causing all the interference! I do not know why all these tests could not have been done on the other less used channel! Whether the story about MET2 was correct I do not know but I tend to be on the practical side and believe that it was in fact MET3!

I have offered to try to attend possibly two extra rallies this year with the co-operation of the Group. I might be able to attend the Longleat Rally this year if arrangements can be made in time. I am hoping to requisition local members help on the stand and even get a look around myself. If this goes ahead and is reasonably successful, I might do the same again but up North as they say. Will it be on the East or West Coast? It will certainly be North of Hull, but that leaves a lot of England, I don't think I can make it North of the Border! If you see Henry at one of these Rallies, take pity on him and give him a hand, if only for half an hour. You will be surprised how rewarding it can be, and also be surprised by who you might meet!

If you feel you have something to share with other readers but don't want to produce a full article about it, why not send it to me and I will try and incorporate it into my Waffles - that should kill it! If it survives that it must be good!

One final thing, do you think it would be worthwhile including a FOR SALE and WANTED section in the Newsletters similar to those in similar Journals? We don't want to invite trouble but a no rubbish unless so described or if working a short term guarantee? More important would be a limit of say 50 to 75 words including address or telephone no. and most important they would have to be connected with our specialised subject, so no plugs for Holiday Bungalows in Wales or Speedboats etc. Your thoughts please. The things that we have advertised have sold well in the past with one exception -- a certain computer!

The final final thing to mention is that our A G M is being held at the RSGB National VHF Convention on Saturday the 12th of May, held at Sandown again at 3.15pm in the "C" lecture stream. I hope to see as many of you as possible there, but don't sit too near the front otherwise you might be put on the committee!

Best Wishes
Henry

A FRAMESTORE FOR APT WEATHER SATELLITE RECEPTION

David Woods

A FRAMESTORE FOR APT WEATHER SATELLITE PICTURES

An Overview

The framestore to be described in this article, provides a high quality, flexible, homebuilt system for decoding and displaying APT type signals from weather satellites. Electronically, the memory is arranged in a 1024 x 1024 array to allow for various permutations of scanning. In my present set-up, I've used 512 pixels by 1024 lines but I intend to add an extra few pixels onto the line length to take in a complete NOAA or Meteosat image.

If a line consists of 512 pixels, then a 32kilobyte RAM chip will hold 64 lines of picture. To store all 800 lines of a Meteosat frame, 13 of these chips will be needed while 8 minutes and 30 seconds of a NOAA pass will fill the 1024 line capacity of the system using 16 chips. Further memory capacity beyond 1024 lines can be added if longer passes are to be stored.

Static RAM was chosen for it's flexibility and simplicity when addressing memory. The use of dynamic RAM requires that all memory locations are addressed at least once every 2 milliseconds and if we were to zoom into a small area of dynamic memory, the unscanned areas would be lost. As long as power is fed to static memory, no data disappears whichever way it is addressed. Although dynamic RAM is slightly cheaper, it restricts the ease of access to memory and was not considered to be suitable for this project. The use of static RAM implied that data would be stored in an 8-bit form because no high capacity static chips could be found with a 1-bit format. I could have used three 8-bit words to hold four 6-bit words but this would have entailed a complex formatting and deformatting circuit. Since I believe in the precept "Keep it simple, Stupid!", I have stayed with 8-bits which give 256 grey levels and a superior performance.
If 8-bits is good enough for professional broadcasting then it's good enough for me!

As with most other display systems, entering picture data into memory is carried out with respect to the APT 2400Hz carrier or a simultaneously recorded pilot tone. I produce line pulses by dividing the frequency of the carrier, though a pulse derived from the APT line tones could easily be added instead.

I made the decision early on, that the display format of the framestore should conform to TV standards so that a large range of monitors could be used and the resulting pictures could be recorded on a video cassette recorder for posterity. I used a dedicated chip to generate all the pulse feeds needed to read data out of the framestore at TV frequencies.

The circuits which read data out of the store are essentialy separate from those which write data into it but the two systems work concurrently so that a picture can be seen forming as it is entered into memory. This is achieved by giving the 'write' sections access to memory only during line sync periods (i.e. beyond the edge of the TV picture when screen data isn't needed anyway).

FRAMESTORE - MODE OF OPERATION

Memory Control Board.

The function of the memory control board is to provide all the required addressing to memory so that the picture is both written into memory as it is played off a tape, and simultaneously read out of memory at a rate conforming to TV standards for display. It is designed in two sections, one to generate the 'write' address and the other to generate the 'read' address. These addresses are sent to memory when appropriate. The 'write' section uses a clock and line pulses from the APT signal to control the address generating counters and a push button is provided to restart the 'write' operation at the start of a fresh picture. The 'read' section uses TV pulses to control counters along with two variable clocks which allow zoom control in both vertical and horizontal directions. The counting can be offset to give scrolling in both directions and the count direction can be changed to flip the picture. Lines of picture can be read out at exactly TV line rate or at a variable rate under zoom control.

The following is a detailed description of the board's operation at a component level.

CONTROL SWITCHING

Push to make switches are used to control the various functions of the framestore except zooming, where potentiometers provide control voltages to two oscillators. Push buttons are provided for the following functions.

SCROLL UP
" DOWN
" LEFT
" RIGHT
SCAN FROM TOP to BOTTOM
" " BOTTOM to TOP
" " LEFT to RIGHT
" " RIGHT to LEFT
LINE SCAN LOCK
" " UNLOCK
RESTART (a new picture)

All these functions use a 'switched earth' system to indicate a pressed button. In this system, an input to a logic block is connected to +5V via a 10kΩ resistor. This holds the input high until ground is applied to it by a 'push to make' switch, when it then goes low. The incorporation of this into each system is dealt with in the relevant explanation.

MEMORY CONFIGURATION

In the basic configuration of the framestore, the memory consists of sixteen static RAM chips of the 62256 type which hold 32,768 bytes of eight bit data each. A line of picture can comprise of 1024 pixels if required but for now we use 512 which means that one chip has a capacity for 64 lines. Sixteen chips will therefore store 1024 lines. The memory organisation therefore can be thought of as a possible matrix of over a million pixels in a 1024 x 1024 array and to address this we need two ten bit busses which carry the LINE ADDRESS and the FIELD ADDRESS. When writing a new picture into the framestore, memory is filled starting at the line with the field address of zero. When reading to a TV screen, the

scanning of memory is very flexible with the ability to read in any direction, from high to low addresses and vice versa, from any position and the area of memory scanned may also be greatly altered with a small scanned area giving a magnified picture on the screen. Scanning a large area gives a reduced image. Since only one address can be presented to memory at any moment, we have to interleave the read and write address in time.

WRITE ADDRESS GENERATION.

There are four main inputs from the APT decoder to this board which are used in the generation of the WRITE ADDRESS.

1. 2.4kHz SQUARE WAVE. This is derived from the APT subcarrier and tracks any off-tape frequency variations.
2. 2Hz or 4Hz LINE PULSE. This indicates the start of a new line and is derived either by detection of the APT line pulse or by division of the APT subcarrier frequency.
3. $\overline{\text{BUSY}}$. (from Analogue to Digital Converter). Indicates, by going low, that the ADC on the decoder board is converting and it's data is not valid.
4. 8-bit DATA BUS. The data bus is left untouched by the memory control board but is distributed on it both to memory and the video output board.

The 2.4kHz square wave is the basic clock for the 'write' section since it dictates the rate at which the decoder is sampling the video waveform, with each sample being be stored as a pixel. It is fed to IC5b, an OR gate which inhibits it if the other input is high. IC5b leads to the clock input of IC3. This is a 12-bit counter of which the ten least significant bits form the LINE WRITE ADDRESS. The eleventh bit is used as a flag to indicate that the ten lower bits have reached their maximum count (1024 counts). It is fed to the second input of IC5b to inhibit the clock and so stops the address from self resetting before a true reset pulse arrives.

IC3's reset pulse is derived from the APT line pulse. A line pulse from the METEOSAT format occurs every quarter second and so IC3 counts to 600 before being reset. However, the NOAA line pulses are at half second intervals and if IC3 were to continue counting after 1024 counts, it would go from zero again for another 176 counts before a true reset occurs (1024 + 176 = 1200). Feeding the eleventh bit of IC3 into IC5b prevents this.

APT line pulses are inverted by IC2b, then gated at IC5c before going to the clock input of IC4, another 12-bit counter of which the ten least significant are used. Since this counter counts lines, it's output forms the FIELD WRITE ADDRESS. As with IC3, the eleventh bit is used as a flag which inhibits IC4's clock after 1024 counts, via IC5c. The count remains stopped until a high is put on it's reset input. This high comes from IC2a, which acts as an inverter for a 'switched earth' signal from a push button. The high on it's normally low output, resets IC4.

A pair of flip-flops, IC1a & b, are used to take the line pulses, which may be of variable mark-space ratio, and generate a short, positive pulse, With the duration of this pulse being equal to the period of the 2.4kHz clock and occuring on the first clock edge after a falling edge of the line pulse. This short pulse prevents IC3 from being held in it's reset condition over a large number of clock cycles.

The inverted APT line pulses are fed through a capacitor, the other side of which is biased at around 3 volts. The falling edge of the incoming

line pulse produces a short, negative spike which sets IC1a, making it's Q output high. This is fed to the D input of IC1b, and the high is transferred to IC1b's Q output on the next clock pulse from the 2.4kHz clock. The complementary output of IC1b meanwhile goes low, clearing IC1a.
The succeeding clock edge passes the low on IC1a's Q output to the output of IC1b and so it stays until the next falling edge from a line pulse at the capacitor.

IC3 and IC4 between them produce twenty address lines which together form the WRITE ADDRESS. Twenty address lines are also generated as the READ ADDRESS. Again these are in two groups of ten called the LINE READ ADDRESS and the FIELD READ ADDRESS.

READ ADDRESS GENERATION.

There are six inputs from the TV Sync Pulse Generator (SPG) on the video output board, which control the 'read' address generation.

1 & 2. CB & $\overline{CB}$. (Composite Blanking) Used to select whether the 'read' or 'write' address goes to memory at any one moment. Also selects whether memory or ADC data is present on the data bus.

3. $\overline{LD}$. (Inverted Line Drive) Resets the 'line read' counter at the end of each TV line.

4. LD. (Line Drive) Gates the line scan oscillator. May clock the 'field read' counter. When gated with $\overline{BUSY}$ from the ADC, forms the Write Enable ($\overline{WE}$) input to memory. It also synchronises the variable frequency field scan clock in LOCKED mode.

5. RI. (Field Ident) By being the least significant line in the FIELD READ ADDRESS, it allows interlace to be realised in the readout of memory when in LOCK mode.

6. $\overline{FD}$. (Field Drive) Gates the field scan oscillator. Resets the 'field read' counter.

The 'read' addresses are produced by counters which are made up by cascading the 74HC191. This TTL chip is described as a binary, up/down, presettable and cascadable counter. It has four output lines and since each address for the line and field is ten bits wide, then three chips are required for each address. By placing a four bit number on the input lines of the chip, they can be made to count from numbers other than zero. In the framestore, this has the effect of altering the position of the picture on the screen, and therefore allows scrolling in both horizontal and vertical directions.

The sense of the UP/DOWN input determines the direction of the count. If low, then the chip counts up. In practice, this permits the picture to be flipped so that compass points of the displayed image can be made correct, regardless of the direction in which the picture was originally scanned.
The implementation of the 74HC191 counters for each 'read' address is given below.

LINE READ ADDRESS

The LINE READ ADDRESS is generated by IC11, IC12, and IC13, with the two most significant lines from IC13 being ignored. The eight most significant inputs, of the ten lines actually used, are fed with an eight bit word from IC17 and IC18. This is the preset input and it's value determines the starting point of the count. The counter is set to this number at the start of a TV line by a negative pulse from the 'line drive' output of the SPG. The count direction is set by feeding the toggle output of a

flip-flop to the U/D pins of each chip. The counter is clocked by a variable oscillator, IC21.

FIELD READ ADDRESS

IC14, IC15 and IC16 provide the FIELD READ ADDRESS but this time only nine outputs from the counter are used. The tenth bit of the address is provided by a feed of RI (field ident), a 25Hz square wave from the SPG, or by a feed of the synchronised field scan clock. Using RI as the least significant bit of the field read address allows an interlace of the scan on alternate fields. With this arrangement, only the even lines are read out during one TV field and the odd lines are read out during the next.
This means that the highest possible vertical resolution is available on the TV screen and as much of a picture as possible can be seen at once without dropping lines. When using the zoom facility in the vertical direction, the advantage of interlace is lost and therefore a data selector in IC24 instead provides a feed of the field scan clock. This is because the clock is at twice the frequency of the counter's LSB and so forms a valid address line. As with the line address system, an eight bit word from IC19 and IC20 is placed on the preset inputs to the counter to give vertical scrolling. These are loaded onto the outputs by a negative pulse of field drive from the SPG.

The counter is clocked by one of two clocks.
1. Another variable oscillator, IC22, generates a variable frequency clock for vertical zooming in the UNLOCK mode.
2. A feed of line drive with positive pulses from the SPG ensures that in LOCK mode, the picture lines are read out at TV line rate to give the highest possible density of picture on the screen without ignoring lines.
The selection of either of these clocks is discussed later. A toggle output of a flip-flop fed to the U/D inputs sets the direction of the count.

INTERLEAVING THE 'WRITE' AND 'READ' ADDRESSES

So far we have generated two addresses. The READ ADDRESS and the WRITE ADDRESS. Each address consists of twenty bits on twenty wires and only one address can be passed onto memory at any one time. The TV waveform, which controls the 'read' operation, can be divided into two parts. The part which carries the picture information is known as ACTIVE PICTURE TIME, and the part which contains the synchronising pulses and where the picture is suppressed is called BLANKING. Obviously we need to 'read' the memory during active picture and therefore blanking can be used to execute the 'write' operation. In other words, the READ ADDRESS should be sent to memory only when blanking is off and the WRITE ADDRESS should be used only when blanking is on. The pulses from the SPG known as 'composite blanking', CB and $\overline{CB}$, are used to control which address is routed to memory. By passing each of the forty address lines through tri-state buffers, which act as gates controlled by CB or $\overline{CB}$, and wiring together the outputs of those buffers which carry the same bit of each address, we can route forty input lines onto twenty output lines. This is done by IC6, IC7, IC8, IC9, and IC10, all 74HC244 type chips.

The 74HC244 carries eight such tri-state buffers and five chips provide all we need. Half of these are enabled by placing a low on pin 1, the other half by pin 19. The chip's pinout is such that the buffers can be arranged in pairs with oppositely enabled outputs appearing on opposite sides of the chip which are easy to connect together on Veroboard. The

idea is to put a particular 'bit' from both addresses onto a tied pair of buffers. The bit from the WRITE ADDRESS goes to the buffer enabled by pin 1. Pin 19 enables the buffer that carries the READ ADDRESS bit and the outputs are both connected together. $\overline{CB}$ is low during blanking and is fed to pin 1 of all the 74HC244 chips. The buffer carrying a WRITE ADDRESS bit is therefore enabled, and passes it's data to memory. The other buffer which is enabled by CB on pin 19 (high during blanking) does not pass it's data on until after blanking is finished. IC6 to IC10 effectively become a large, twenty way changeover switch.

The circuits which service the 'read' counters with their control signals are discussed below.

CLOCK GENERATION

The rate at which the counters are clocked, determines the rate at which data is read from memory. A slow clock means that few pixels will be read out during the active picture and the picture will appear to have stretched or expanded. Conversely, a fast clock means many pixels are shown in the given time thus compressing the image.

LINE SCAN

The line scan clock is achieved by one half of IC21, a 74LS629, dual 'voltage controlled oscillator' (VCO), which has a 10:1 frequency control range, a TTL compatible output and a maximum frequency of about 20MHz. A 10MHz clock would read out all 512 line samples in the active line time of 51.5us, so in this case a 100pF capacitor forms the timing element, setting the upper frequency at 12MHz to permit a degree of compression. A 25kΩ linear pot is connected across +5V and 0V with it's wiper providing the control voltage for the VCO. A 10µF capacitor between the wiper and 0V smooths the variations in the CV giving a pleasant feel to the zoom adjustment. The control range of the VCO is set by a 22kΩ preset pot. The oscillator is disabled at the end of each line by a positive pulse of line drive fed to the VCO's 'enable' input. This synchronises the resultant clock with the TV pulses so that vertical edges on the screen do not appear ragged. The second VCO on IC21 is unused.

FIELD SCAN

The field clock, of which there are two, determines the rate at which lines are read out of memory. In LOCK mode, one line of memory is read out for every TV line. The clock rate is therefore 15.625kHz and the clock is a feed of line drive with positive pulses. IC22, another dual VCO chip generates a variable clock which is fed to the 'field read' counter when in UNLOCK mode. The setup for this VCO is the same as for the line scan except a 100nF capacitor gives it an upper frequency limit of about 20kHz and it is synchronised by positive pulses of field drive. This clock is further synchronised by IC25a, a D-type flip-flop which has line drive on it's clock input. This ensures that transitions from one line to the next only occur at a TV sync pulse. However, to avoid interference between the clock and line drive, the frequency range of the clock is given an upper limit of 7.8kHz (half line frequency) and this restricts the vertical magnification to x2 or greater. Bypassing the flip-flop allows picture manipulation around x1, including compression but also gives strobing effects due to line-to-line transitions taking place during active picture time. The second oscillator in IC22 is part of the scrolling generator section of the circuit.

Switching between LOCK and UNLOCK mode is carried out by IC24a & b, a 74HC157 quad, 2-input data selector. From two push buttons, flip-flop IC25b generates a toggle output which controls the data selector. If the f-f output is low then LOCK mode is active and IC24a routes line drive to the 'field read' counter clock inputs with IC24b routing RI to be the LSB of the FIELD ADDRESS. This gives a stable, fully interlaced picture showing 575 lines of memory which is the most that can be shown on the 625 standard.

In UNLOCK mode, with the flip-flop high, the synchronised field scan clock is routed via both IC24a & b to the counter and to the LSB of the address.
Picture zooming in the vertical as well as horizontal direction is now possible.

X-Y SCROLLING

As previously mentioned, by placing an eight bit word on the preset inputs of the 'line and field read' counters, the start of a count may be offset from zero, thereby offsetting the picture on the screen. By generating this eight bit word with a counter and making it count up or down, the picture can be made to scroll across the screen in both directions. Again the 74HC191 is used with two chips being cascaded to give an eight bit counter. IC17 and IC18 provide the preset address for the 'line read' counter. IC19 and IC20 are responsible for the presetting of the 'field read' counter. The enable inputs of the two counters (pin 4 of IC17 and IC19) are fed from AND gates which signal to the appropiate counter that a button has been pressed. That counter, once enabled, begins to count pulses from the second oscillator in IC22. Two of the four switches also provide the flag which determines the count direction and thus the direction of scrolling.

APT Decoder

The decoder is of a common design and is built around only two chips. It is essentially identical to decoders used in the YU3 UMV framestore, Martelec's MSS20 decoder and Cirkit's decoder.

The components up to, and including IC1a, form a bandpass filter which removes signals of a higher and lower frequency than those found in the APT signal. Such signals (like mains pickup at 50Hz) if allowed to pass would interfere with the picture. IC1b & IC1c and the surrounding components, extract the picture (video) signal from the APT signal. The greater the amplitude of the 2400Hz tone going into the two diodes, the higher the mean voltage coming out. The components leading to the input of IC1d, filter off the remaining 2400Hz tone leaving a video signal with a frequency bandwidth of 0 to 1100Hz, which IC1d sets to the correct level for the A to D converter. The rectifier modification shown in RIG newsletter No. 18, page 41 can be applied to this decoder.

IC2 is an 'analogue to digital converter' which takes the video signal and, within 10 microseconds, generates an eight-bit binary number which represents the incoming voltage level as compared to a reference voltage.
The 2.4kHz square wave derived from a PLL tells the ADC via the $\overline{WR}$ input, to begin doing its conversion and the chip tells the framestore at IC2d that it has finished converting via the $\overline{BUSY}$ output. The 8-bit data is then accepted by the framestore along the eight digital data lines.

The line sync generator in the small diagram may very well not be the best or cheapest way to realise it's function but it works! The APT signal has a 'subcarrier' frequency of 2400Hz, each line lasts 1/4 of a second and therefore there are 600 cycles of the APT tone in each line of picture.
IC3 is known as a 'phase locked loop' (PLL) which simply locks onto the APT tone, generating nice, square pulses at pin 4 which are exactly in sympathy with the 2400Hz subcarrier, even if this has short term variations in it's frequency (i.e. if played from a cassette recorder).

IC4 counts these pulses from the PLL and with every 10 pulses counted, gives one pulse on it's pin 12 (therefore it's output frequency is 2400/10 = 240Hz). IC5 does the same job but to IC4's output pulses and it's output frequency is 240/10 = 24Hz. IC6 is the same chip again but it is wired differently. When it reaches the 6th input pulse from IC5, it sends out a pulse from it's pin 5 which resets all three chips and they then start counting from zero again. Six other pins (1,2,3,4,7 & 9) on IC6 identify a different stage of the count to six, and each therefore has a pulse rate of 4Hz (24/6) but the pulse on each pin happens at a different time. The selection of one of these can be used to position the picture on the screen.
Remember; this method of synchronising to the APT lines, totally ignores the in-built line tones that the APT system already carries and so the user must select the 4Hz output which is closest to the APT line pulse at that time. An alternative method of synchronising line pulses is to disconnect the APT tone input to the PLL which freeruns. The tone is reconnected once correct sync has been achieved. The rate at which sync is achieved can be set by the pot on pin 8 of the LM565 PLL.

Since the Meteosat APT signal has 4 lines per second, then A 4Hz pulse is all that is needed to feed to pin 4 of IC2b on the framestore. However, the NOAA satellites give 2 lines per second and thus IC7, a 7474 D-type flip-flop has been used to divide the 4Hz output by 2, to give a 2Hz pulse which also goes to the framestore if required.

The video signal from APT can be sampled to a finer resolution by making the PLL lock to a harmonic of 2400Hz (say 4800Hz) and using the spare flip-flop in IC7 to further divide the line pulse frequency by two.

Video Output Board

The video board consists of two circuits:-
(a) Synchronising pulse generation.
(b) Digital to analogue conversion and processing.

The Synchronising Pulse Generator (SPG) is based on a single chip, the SAA 1043, which requires only a 5MHz crystal reference, to supply all the important pulses. Although the circuit's specifications require a power supply voltage of +5.7V to +7.5V, a 5V supply was found to be adequate. It is possible to configure this SPG to allow it to lock to an external video reference should this be required. Some of the pulse outputs are used extensively within the framestore, others need to be inverted and since the chip has CMOS outputs, all pulses which are used are either buffered or inverted before being fed to the 'memory control board'.

The data bus from the 'memory board' is fed to the D to A converter via a 74HC244 octal buffer. Not only does this buffer the data bus, it can also be used to add black level to the resulting video signal during the

blanking period. This is achieved by feeding CB (the 'composite blanking' signal) to the enable inputs of the '244, which forces the buffer outputs into their high impedance state during the blanking period. A 1kΩ resistor (within a S.I.L. package) from each buffer output to ground, pulls each line low during blanking, and since these lines are fed to the DAC, then it will produce the voltage that represents zero on it's input which of course represents black.

The Digital to Analogue Converter, a DAC-08CP high speed device, is powered from + & -12V and gives roughly a 1V p-p signal across a 1kΩ resistor to ground. A TL084 op-amp buffers this signal with a d.c. bias added by a 2.2kΩ resistor to +5V. This op-amp has unity gain and feeds a CMOS switch (type 4016 or 4066) which becomes open circuit for the duration of the TV sync pulse from the SPG. During this period the other CMOS switch closes, passing a preset voltage from a pot. The summed output of these two switches, only one of which is on at any one moment, is buffered by a further op-amp stage which gives the final video output. The d.c. bias from the first op-amp (IC3a) is set so that black level is about half a volt above ground. Since the preset voltage at the second CMOS switch is only passed during the sync pulse interval then by adjusting it to be 0.3V below black level, a sync pulse is formed within the video signal.

SPG WAVEFORMS

The waveforms required from the SPG, and their characteristics, are as follows:-

1. MIXED SYNCS. (MS) Known by the chip maker as composite syncs. This waveform represents the basic television synchronising waveform and contains both line and field pulses. It is both buffered and inverted to provide two opposite phases of the same signal. They are used to control the two CMOS switches at the output of the DAC to switch in the sync pulses at the correct voltage level.

2. COMPOSITE BLANKING. (CB) This waveform defines the period in a TV signal when no picture information is allowed and thus it makes room for the sync pulses to be inserted. Both polarities are required of it. The inverted version (low during blanking) enables the write address at the address buffers (fed to pin 1 of each chip). It is the 'output enable' ($\overline{OE}$) signal for the ADC. The uninverted version goes to pin 19 of the address buffers and enables the read address. It enables the memory outputs and disables the data bus buffer on the Video Board during blanking.

3. LINE DRIVE. (LD) This is the same as MS but without a field pulse and again both polarities are made available. The inverted version (sync pulses low) is the load signal for the 'line read' counter. The opposite phase is used in LOCK mode to clock the 'field read' counter. In UNLOCK mode, it synchronises the variable frequency field scan oscillator. It is gated with $\overline{BUSY}$ from the ADC to form the $\overline{WE}$ (write enable) signal for memory.

4. FIELD DRIVE. (FD) Indicates the start of each TV field. This is inverted and becomes the load signal for the 'field read' counter. It is inverted again at IC2c to synchronise the field scan oscillator.

5. FIELD IDENT. (RI) This is a 25Hz square wave which identifies the odd and even fields of the 625 line TV frame. When scanning memory from top to bottom in LOCK mode, the uninverted version is required as the LSB of the field address. Changing the scanning direction requires the opposite polarity and this selection is at present achieved by a changeover switch.

IC6, a quad AND gate (74HC08), provides four buffers with the other input

of each gate being tied to Vcc. Five inverters are provided by IC7, a 74HC04.

It is worth noting that the SPG will work to various line standards other than 625/50Hz. e.g. 525/60Hz NTSC.

Memory Board

In circuit terms, the memory board is the simplest of the systems in the framestore, with only two types of chips in it's design, sixteen memory chips of the 62256 or 43256 type and a 74HC154 decoder to select which chip is active via the $\overline{CS}$ (Chip Select) input. The practical aspects of building memory are rather more difficult. The sixteen chips have 28 pins on each one, and 27 of these must be connected in parallel with the same pin on the other memory chips; i.e. all the 'pins 1' are connected together, as are the 'pins 2' and so on for all the pins except the 'pins 20'.

This is not easy to do if all the chips are laid flat on veroboard and wired together, and the result may be prone to errors and shorts. Without resorting to making a PCB, construction of the memory board was made easier by using a 'veroboard sandwich. A piece of veroboard measuring 170 holes by 36 tracks was split in two giving two lengths, one with 20 tracks and the other with 16 tracks. Sixteen i.c. sockets, for the 28 pin memory chips, had their pins bent sideways and, starting 11 holes from one end of the wider piece, were soldered in at nine hole intervals on one side of the board. The sockets were oriented so that pin 20 would eventually appear on this board. Five of the six spare tracks carry power and the four most significant lines of the field address to the decoder which is situated at the far end of the board. The second piece of veroboard is mounted on the other side of the sockets and soldered in place. This technique executes all the parallel wiring between the memory chips with the address, data and control connections being brought out to one end of the board. The CS pins are hand wired to the appropriate output of the decoder at the other end.

ADDRESS BUS WIRING

As previously outlined, there are twenty address lines fed from the Memory Control board to memory. The ten least significant address lines are for addressing pixels within a line of picture, while the other ten determine which line, out of 1024, is written to, or read from at any moment. In my present configuration, I am using 512 pixels to a line which requires nine address lines so the tenth bit of the line address is not fed to memory. Instead, it forms the enable signal for the 74HC154, 'one-of-sixteen' decoder, but if I wish to double the line length, I need only feed it to the tenth address input of the memory chips and move the other address connections along one. This would also mean that each chip would only store 32 picture lines with a total line storage of 512.

To view the entire width of a Meteosat picture (excluding the sync pulses), we need only add 64 pixels to the present line length of 512 pixels. This narrow strip of memory (64 x 1024) can be realised by using two further 32k memory chips wired up as follows. Since 64 pixels require six address lines, the six least significant bits of the line address go to the same on the supplementary chips. The tenth bit, which already enables the 'one-of-sixteen' decoder for the main memory, is inverted and then enables a 'one-of-two' decoder. All the other bits of the address bus

go to the address inputs of the two chips in order except for the most significant bit which is fed to the input of the decoder. The decoder's outputs go to the appropriate Chip Select inputs.

THE VIDEO BOARD REDESIGNED

For a time, the video board was used with a converted black and white domestic TV set. This 'monitor' had the advantage of being cheap and it gave reasonable resolution as well as having a high input impedance. More importantly, the latter feature allowed me to use conventional op-amps as buffers for the video signal, since good ones were handy and are easy to implement. The particular op-amp used, the TL084, has FET inputs which take virtually no current from their signal source. They also have, for an op-amp, a very high slew rate and at unity gain can buffer a video signal very well, providing they are not working into a low impedance load. If a 75 ohms load is used with this op-amp, it's frequency response shows a marked degradation.

I wanted to achieve a better quality display for the pictures I was receiving and so I bought a 9" black & white monitor from J & N Bull Electrical. This was uncased, had no power supply and required separate feeds of line and field syncs but it was brand new, known to be pin sharp and at less than half the price of the cheapest TV or monitor available in the shops, I wasn't complaining. However, it's 75 ohm input and it's resolution meant I had to completely redesign the video output board of the framestore.

Many items of video equipment such as monitors and VCRs have 75 ohms as the impedance of their video input in order to match the characteristic impedance of standard coaxial cables, and when the monitor was acquired for the framestore, it began to show up several shortcomings of the existing video processing. Firstly, it's 75 ohm termination reduced the frequency response of the final op-amp which then had to be replaced and since the monitor required seperate feeds of sync pulses, I could dispense with the CMOS switches also and use a sync free video waveform with appropriate pulses being fed direct from the SPG. I returned to the YU3 UMV design for the DAC and video amp, using a NE592 video amp instead of the uA733 and a 2.2kΩ resistor across it's gain select pins gave approx 2.5V p-p video into 75 ohms.

When the framestore output was now viewed on the monitor, it was quickly apparent that areas of the picture were covered with little light sparkles, whose distribution corresponded to a group of three memory chips made by Sony. The other chips, from Hitachi, showed a much lesser degree of sparkle. The phenomenon was caused by the data lines going into the DAC, changing state at slightly different times and so a 74374, an 8 bit latch, was used to pass data to the DAC once the state of the data lines had settled. A feed of the line scan oscillator output was used to clock the latch. When this oscillator generates a clock edge, it takes well over 100 nanoseconds for this event to propagate through the line read counter, the address buffers and the memory itself to return the new data. If a feed of the same clock edge is to latch the new data into the DAC then it must be delayed to arrive at the latch chip just after that data and this was achieved by feeding it through eight buffers within a single 74244, each of which provide approx 20nS delay.

It is possible to obtain DAC i.c.s which have inbuilt data latches though to achieve a high sample rate, it was found to be cost effective to add

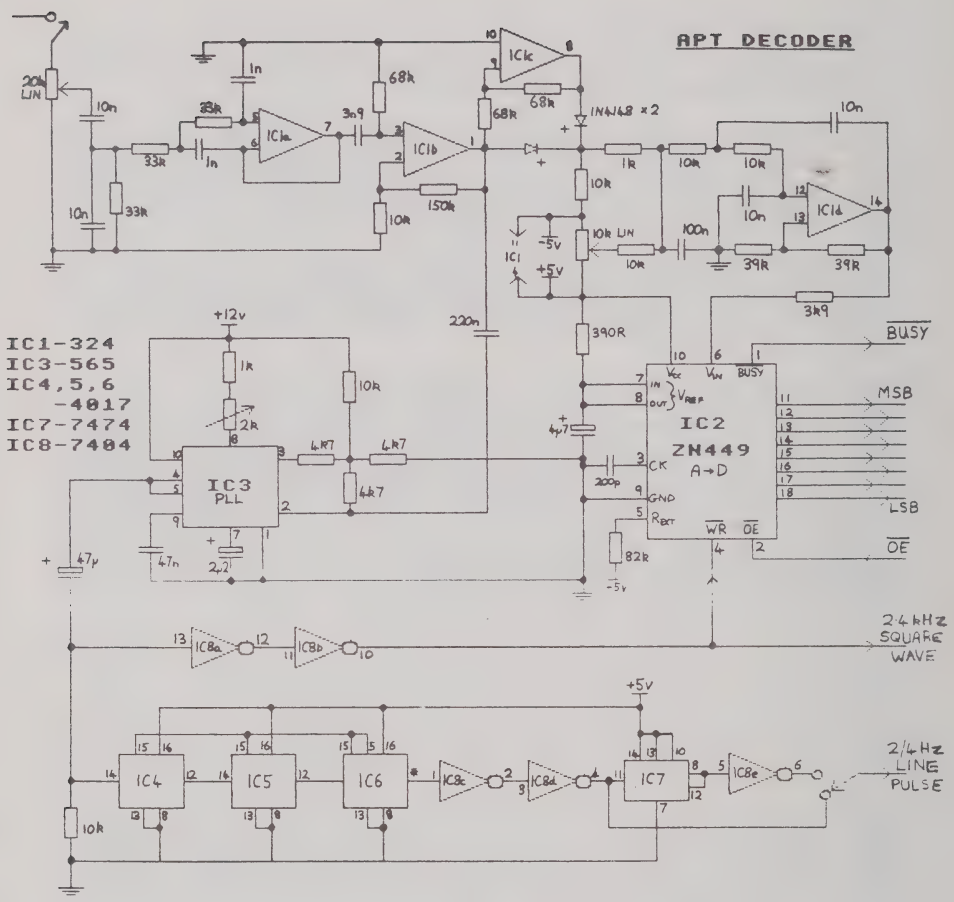
external latches. Plenty of these and other useful TTL chips were extracted from redundant arcade machine boards.

Having latched the data, I found no more disparities between memory chips though I could still see slight glitches at the boundries of two pixels where the most significant bit of the data bus was changing and I guessed that either the MSB was early or late with respect to the other seven data bits. It turned out to be late and this was cured by delaying the other bits each with a buffer from a further 74244.

These improvements give stunning, almost photographic results from the framestore and the only existing problems are that my monitor does not blank the electron beam during field flyback though this is usually difficult to see. I also plan to add syncs to a separate feed of the video signal for feeding to a VCR.

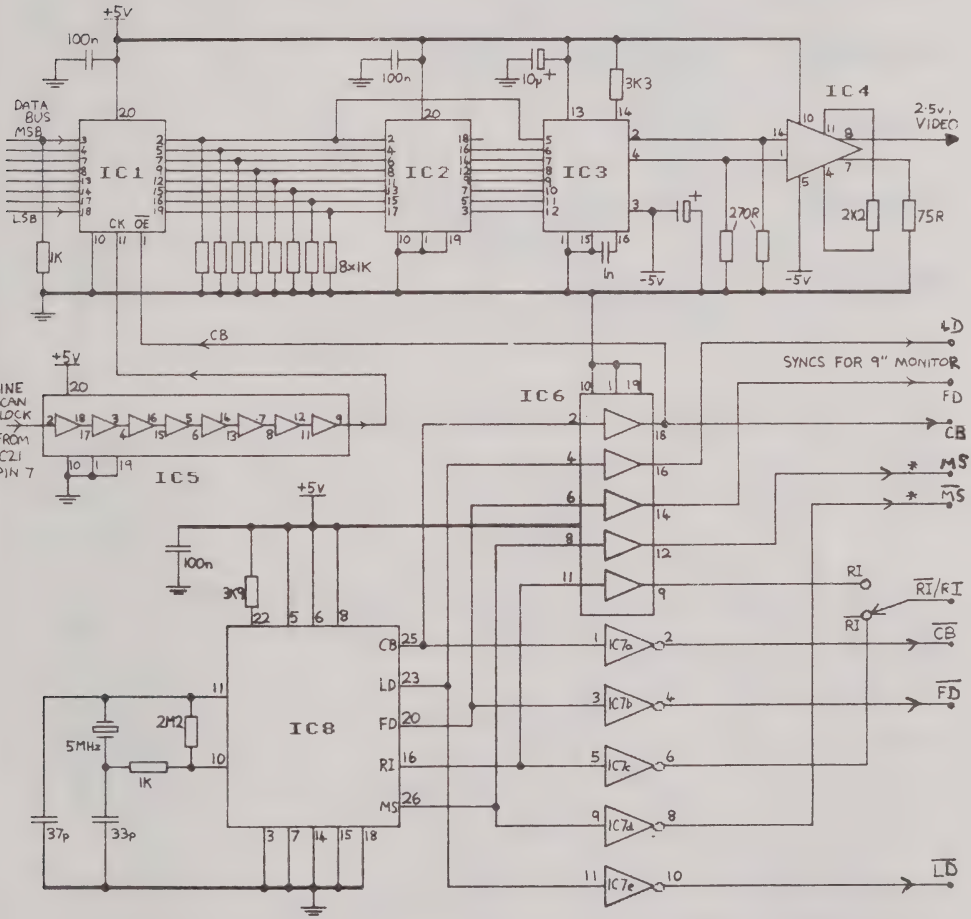
These changes mean that the -12 volt power supply needed for the early video board is now not required. Overall, of the Mk. 2 video board is used, then the requisite power supplies are: +5V for nearly everything, -5V for the analogue systems and +12V for the PLL circuit. I use a PSU from an early BBC micro as these have been available recently for less than a fiver from Greenweld Electronics. It will supply +5V at upto 2.5 amps and -5V at 100mA though the use of 74HC TTL chips helps keep power consumption down while also reducing the level of RFI emanating from the framestore. The +12V supply was homemade along conventional lines using transformer, rectifier, capacitor and regulator. I have found that +15V will work perfectly instead of +12V.

Diagram 1

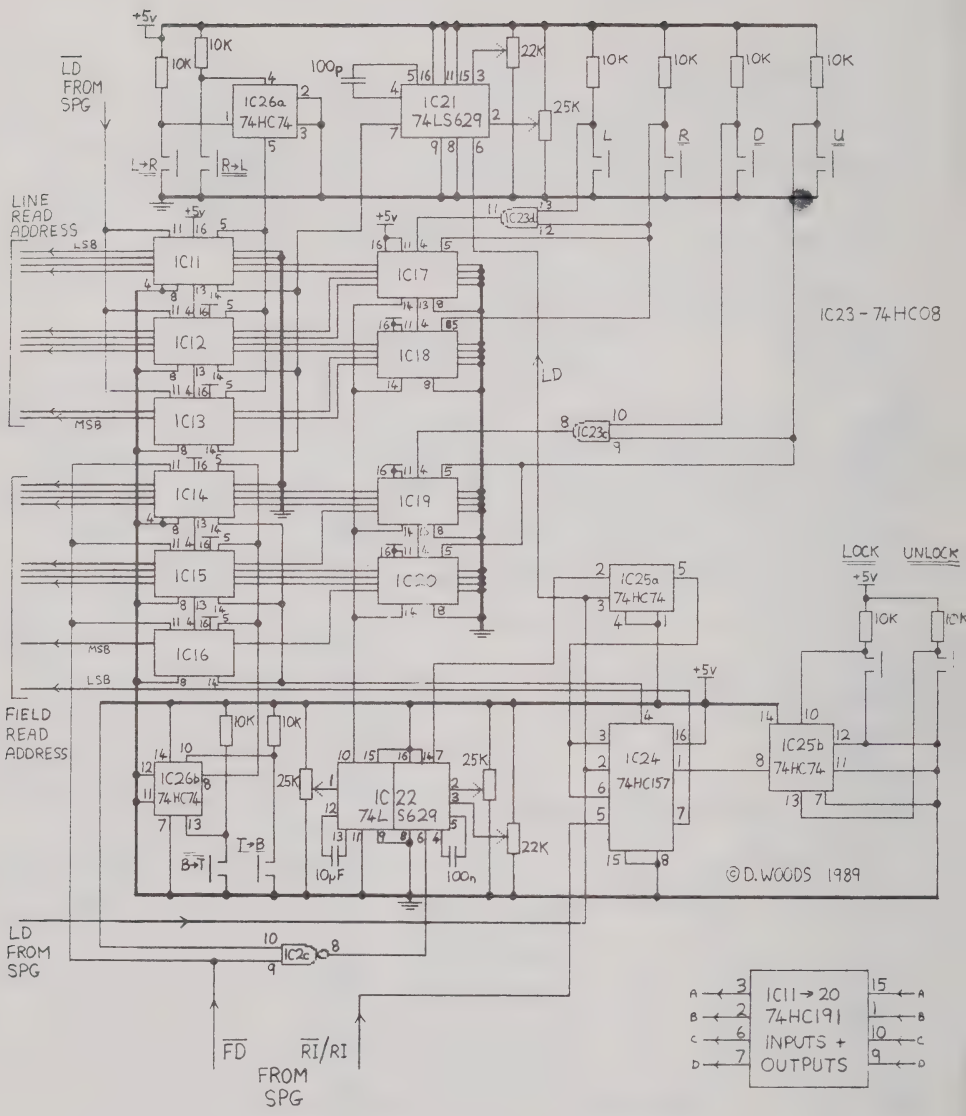

APT DECODER
IC1-324
IC3-565
IC4,5,6
-4017
IC7-7474
IC8-7404
IC2
ZN449
A→D
IC3
PLL
BUSY
MSB
LSB
OE
24kHz
SQUARE
WAVE
2/4Hz
LINE
PULSE
IN4148 x2
+12v
+5v
-5v
* PIN 1,2,3,4,7 OR 9

VIDEO OUTPUT BOARD
AND
SYNCHRONISING PULSE GENERATOR

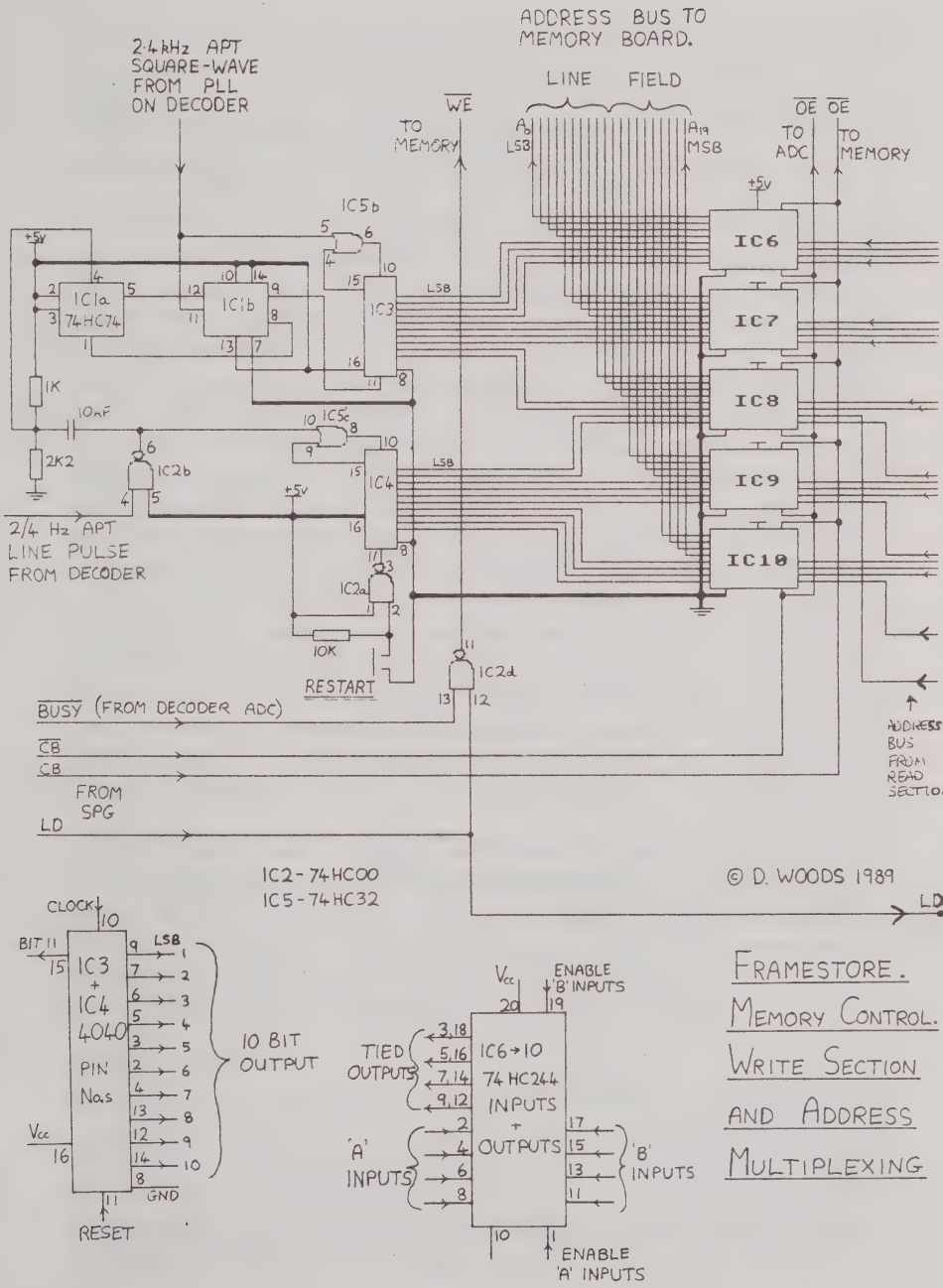
IC1 - 74LS374
IC2 - 74LS244
IC3 - DAC08 (OR 0S08)
IC4 - NE592
IC5 - 74LS244
IC6 - 74LS244
IC7 - 74LS04
IC8 - SAA 1043



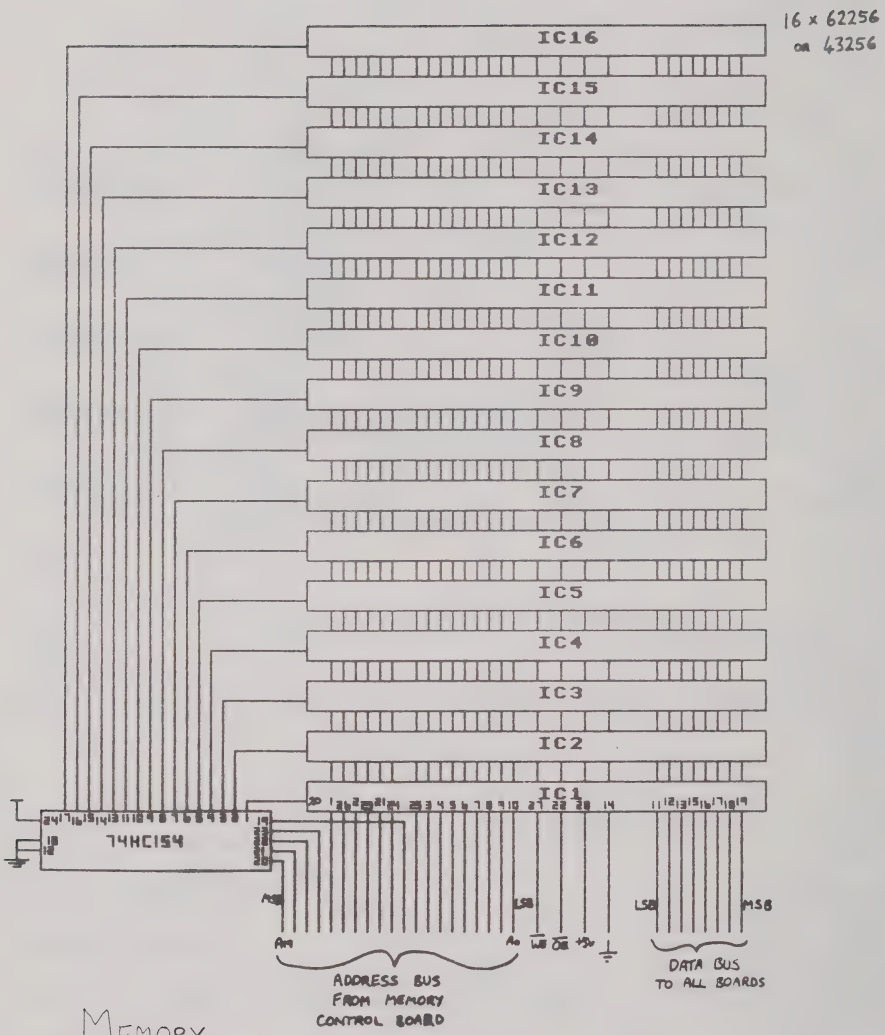
* FOR ADDING SYNCS TO VIDEO LATER



FRAMESTORE.
MEMORY CONTROL.
READ SECTION



FRAMESTORE. MEMORY CONTROL. WRITE SECTION AND ADDRESS MULTIPLEXING



MEMORY
BOARD

An Explanation of Kepler Elements
by Richard Osborne GW4BVT

In the course of putting together my satellite receiving system, I had decided that I would write my own program for satellite orbit prediction. This was partly because I hoped to find it an interesting exercise and partly because I have a Sinclair QL and I don't know of any source of commercially produced prediction programs.

The first task was to locate books and articles which would give me the information I needed to write the program. This turned out to be a harder process than I thought. I contacted AMSAT UK to obtain a copy of "Satellite Tracking Software for the Radio Amateur" but was informed that this was out of print and no longer available. So on to other sources to give the mathematical formulae and an explanation of the Kepler elements given in each issue of the RIG newsletter. As far as the formulae were concerned, I found virtually everything in chapters 8 and 9 of the ARRL Satellite Experimenters Handbook available from the RSGB. However, try as I might, I could not find a clear and concise explanation of the Kepler elements; what they are and especially the units of measurement. I suspect that most people with prediction software just plug the numbers into their computers without understanding the relevance of each element. Anyway, after much wailing and knashing of teeth, I managed to work out what I wanted and produce working software. Well, working to the extent that the satellites appear at about the right time. So for the benefit of others who wish to know about the mysteries of Kepler elements, I present my version.

Kepler elements are named after Johannes Kepler who, in the early 17th century, formulated laws of planetary motion around the sun based on observation. These laws are equally applicable to artificial satellites orbiting the Earth and they form the basis of the mathematics which enables satellite positions to be calculated at any point in time. However, now to the elements themselves.

SEMI-MAJOR AXIS

The first property to define for a given satellite is the size and shape of the orbit. Kepler's first law implies that a satellite will orbit around the Earth in an ellipse with the centre of the Earth (geocentre) at one focus of the ellipse. A diagram of an elliptical orbit is shown in Fig 1. The line joining the furthermost parts of the ellipse is called the major axis and has a length of 2a in the diagram.

The length a is known as the semi-major axis or SMA for short. Where this is given in the list of Kepler elements, the unit of measurement is in kilometres. If the value is not quoted, all is not lost as it can be derived from one of the other elements.

ECCENTRICITY

The shape of the ellipse is defined by the element called eccentricity. This is a dimensionless number whose value can vary from 0 to 1. A value of 0 means that the ellipse is, in fact, a circle and a value of 1 means that the ellipse is a parabola with the major axis stretching to infinity. Most polar orbiters are in an orbit which is almost circular so the value of eccentricity for these satellites is close to 0.

MEAN MOTION

Now life becomes more complicated when considering the motion of the satellite around the orbit. Kepler's second law implies that for any orbit except a purely circular one, the velocity of the satellite will vary during the course of the orbit. It is this fact which makes the calculations for an elliptical orbit more difficult than those for a circular one. The satellite motion is defined by the element called mean motion. This is is number of complete and fractional revolutions that the satellite makes in one solar day i.e. 24 hours. It can be referenced to any point on the orbit. I stress the solar day because another type of day - the sidereal day - is required during the course of the orbital calculations. Be careful with the fractional element of mean motion. This represents the fraction of an orbit in time but not necessarily the same fraction in distance because of the variation of velocity mentioned earlier.

ACCELERATION

Unfortunately, we live in an imperfect universe and the mean motion is not constant over time. Even at an altitude of 850km which is typical for a polar orbiter, there is atmospheric drag affecting the satellite. The drag, incidentally, is worse at periods of high solar activity such as the present time because the Earth's atmosphere expands under the bombardment of solar particles and becomes denser at the orbit height. A severe solar storm such as that experienced in March 1989 can significantly alter the orbital parameters. When the satellite meets drag from the atmosphere, its orbit decays. But, contrary to intuition, the velocity increases because of the conservation of angular momentum. The Kepler element which defines the change of mean motion is the acceleration although it may also be called the drag factor.

It has units of revolutions per solar day per solar day. It almost always has a positive value which represents increasing velocity. So after one complete day, the mean motion will have changed by the value of the acceleration taking the sign into account. Note that the value given in the published elements is only a first approximation as the actual decay of the orbit is extremely complex. It is, however, adequate for amateur purposes.

EPOCH OF DATA

Now to introduce the term epoch of data. This is a fancy way of stating the point in time at which the Kepler elements quoted are valid. Note that the elements are valid at, and only valid at the time and date defined by the epoch. It is split into the epochyear and epoch day which may be given separately or, as in the case of the elements printed by RIG, combined into one. The epoch year is self explanatory being the same as the calender year. The epoch day represents the number of complete and fractional days that have elapsed from the beginning of the year to the time at which the Kepler elemnts are valid. It is referenced to Universal Time (G.M.T). To stay in line with the calender days, a value of 0 for the epoch day is defined as midnight on January 0th so that on the first real day of the year (Jan 1st), the epoch day starts with a 1. A typical epoch value is 89230.913459. This is 1989 (the 19 is omitted for brevity), day 230 and a fraction 0.913459 of that day.

MEAN ANOMALY

The next step is to determine the position of the satellite in the orbit at epoch. But, to enable the position to be defined, a reference point is needed. The one that is used is the PERIGEE. This can be defined as the closest point of approach to the geocentre by the satellite and it lies on the intersection of the major axis and the orbital path. This is shown diagrammatically in Fig 2.

Now that we have the perigee as the reference, we can define the position of the satellite relative to this point. The element that caters for this is the mean anomaly where anomaly is a fancy name for an angle. It can be quoted in any unit of angle measurement although degrees are used by RIG. To understand the mean anomaly, imagine that instead of being an ellipse, the satellite orbit in question is a circle with the same diameter as the major axis of the ellipse. Now draw a line from the centre of the circle to the satellite. The angle subtended from this line to the line joining the centre of the circle and the perigee is the mean anomaly. Fig 3. shows this diagrammatically.

Because the orbit of the satellite is now defined as circular, its velocity does not alter so the change of mean anomaly with time is constant. Therefore, with the mean anomaly, we can define a portion of an orbit IN TIME that a satellite has travelled. For instance, a mean anomaly of 90 degrees means that the satellite is a quarter of the way round the orbit in time. Note that for a non-circular orbit, this does not correspond to the same proportion in distance.

Once the orbit shape and satellite position has been established, the orbit needs to be referenced to the terrestrial co-ordinates of latitude and longditude. Imagine that the ellipse corresponding to the satellite orbit is drawn on an infinitely large plane surface. This is called, not surprisingly, the orbital plane and will pass through the centre of the Earth. Imagine also an infinitely large plane drawn through the equator of the Earth which is called the equatorial plane. As the Earth revolves on its N-S axis and around the sun, theoretically, the orientation of the satellite orbital plane remains fixed in space relative to the stars. In practice, the non-uniformity of the Earth's gravitational pull causes the orbit to move but at a rate that is easily predicted by mathematics.

INCLINATION

Fixing the satellite orbital plane in space relative to the equatorial plane is a 3 dimensional problem. It is defined using the polar system of co-ordinates with the centre of the Earth as the origin. This is because the equatorial and orbit planes always intersect at this point. Three angles are needed to fully solve the problem. The first angle is the element called inclination and it is the angle between the orbital and equatorial plane. It usually has units of degrees and can have any value between 0 and 180 degrees. The angle is measured along a theoretical plane which is perpendicular to both the orbital and equatorial planes. It can also be defined as the angle between the two planes where they intersect on the Earth's equator.

For all cases except where the planes are perpendicular, two different values of inclination could be derived which will always add up to 180 degrees. A convention is required therefore to select the correct angle. Imagine that you are sitting in spacelooking back at the Earth with the north pole at the top. A fixed point on the equator will move from left to right or west to east because of the Earth's rotation. Imagine also that you can see a satellite orbiting the Earth and that it is about to cross the equator travelling from the southern to northern hemisphere.

If the horizontal component of the satellite is towards the east in the direction of the Earth's rotation, then the angle of inclination will be less than 90 degrees. Conversely, if the horizontal component is towards the west i.e. against the Earth's rotation, the angle will be over 90 degrees. Fig 4. demonstates two possible values.

RIGHT ASCENSION OF THE ASCENDING NODE

The second angle is called the right ascension of the ascending node. This is the angle between a line from the geocentre to the FIRST POINT OF ARIES and the line from the geocentre to the ASCENDING NODE measured along the equatorial plane. It is quoted in degrees by RIG.

Now for an explanation for the terms above. If a line is drawn along the intersection of the orbital and equatorial planes, this line will intersect the Earth's surface at two points called NODES which are diametrically opposite each other. To distinguish between them, they are called ascending and descending nodes. The names are derived from the motion of the satellite. The half of the orbit where the satellite will cross the equator going from south to north contains the ascending node, while the half where the satellite will travel from north to south has the descending node.

Right ascension is one of the co-ordinates used by astronomers to map the positions of stars and it is similar to the longditude on Earth. The celestial equivalent of the Greenwich meridian or 0 deg is called the First Point of Aries. It can be defined as follows: First, imagine a plane containing the Earth's orbit round the sun. Now, where the Earth's equatorial plane intersects this orbital plane (the Earth's axis is tilted at 23.5 deg), a line can be drawn. In one direction from the geocentre, this line points in the general direction of the constellation of Aries forming the celestial meridian (First Point of Aries). Right ascension is measured in degrees EAST of the First Point of Aries. This is in contrast to satellite longitudes which are normally measured WEST of Greenwich. So we now know where the satellite orbit crosses the equator at epoch with respect to the stars. However, to be of use, this needs to be translated into the terrestrial longitude. This involves a calculation involving sidereal time.

ARGUMENT OF PERIGEE

The final element is the argument of perigee and this fixes the position of the perigee relative to the Earth's equatorial plane. It is the angle measured between a line joining the geocentre and the ascending node and a line joining the geocentre and perigee in the plane of the satellite orbit. This angle is shown diagrammatically in Fig 5.

Now a cautionary note. At epoch, the right ascension of ascending node defines the celestial longitude of the ascending node. This refers to the orbital plane and NOT the satellite which can be anywhere in the orbit and not necessarily over the equator. However, by convention, the satellite usually is close to the ascending node at epoch. For circular orbits or near-circular orbits, this can be verified by adding the angles of MEAN ANOMALY and ARGUMENT OF PERIGEE. The result should be close to 360 deg.

Some parameters are given with the Kepler elements for information only such as the orbit number. However, even this seemingly simple parameter is fraught with difficulty. I know of two definitions of a satellite orbit.

1. The distance travelled by the satellite from one ascending node to the next.
2. The distance travelled by the satellite from one perigee to the next.

Now the perigee and ascending node rarely coincide, and, to make matters worse, the perigee can move in space relative to the ascending node. I do not know the definition of orbit given in the RIG newsletter. Perhaps the secretary will be kind enough to enquire of Herstmonceaux. I have established that WeatherWatch UK uses the ascending node as the reference point, and I assume that the number given refers to the orbit about to begin.

A second note of caution. In a perfect universe, the satellite orbit will remain fixed in space relative to the stars. Unfortunately for orbital calculations, the Earth is not a perfect sphere but an oblate spheriod as it bulges around the equator because of spinning on its axis. The effect of this is to cause the orbit to move in space. The inclination will remain fixed but the right ascension of the ascending node and argument of perigee can vary over time and the amount of variation depends upon the inclination.

After sorting out the Kepler elements, I wrote a prediction program in SuperBasic. The output is purely numerical as I have not had time to play around with graphical maps of the world. I can display in tabular form the latitude, longditude, azimuth, elevation, altitude, range and orbit number at a given time (usually the current time derived from a real time clock) for all satellites simultaneously. This part of the program was reasonably easy to write. What I found much more difficult was working out how to predict the times for aquisition and loss of signal. I produced a method that gives acceptable results and use this to give me a presentation of the AOS and LOS times for all the satellites stored on the computer over one complete day. This is the output that I use most often.

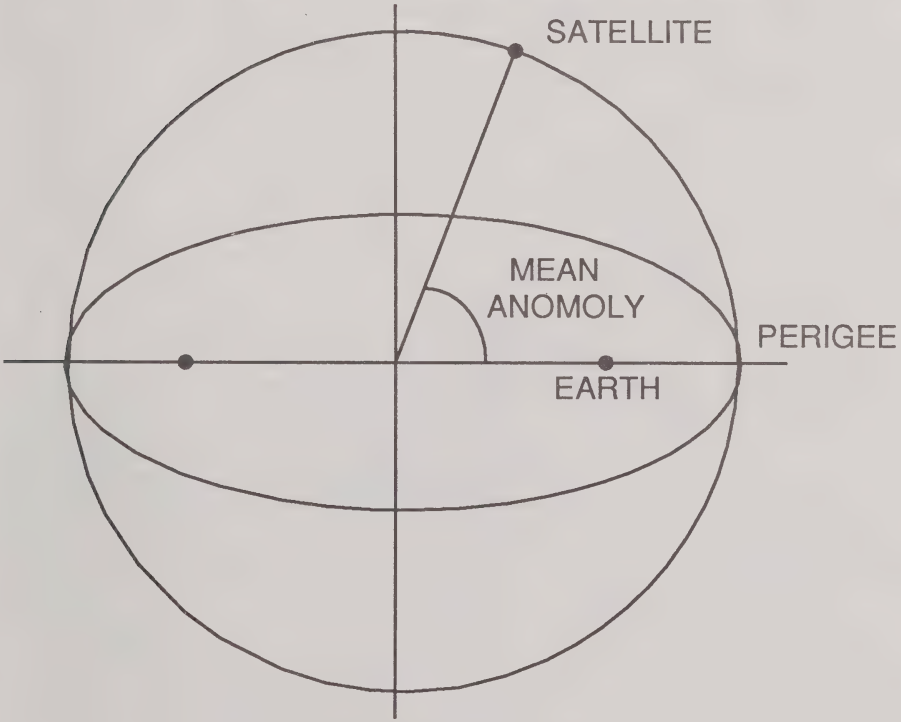


Fig 3

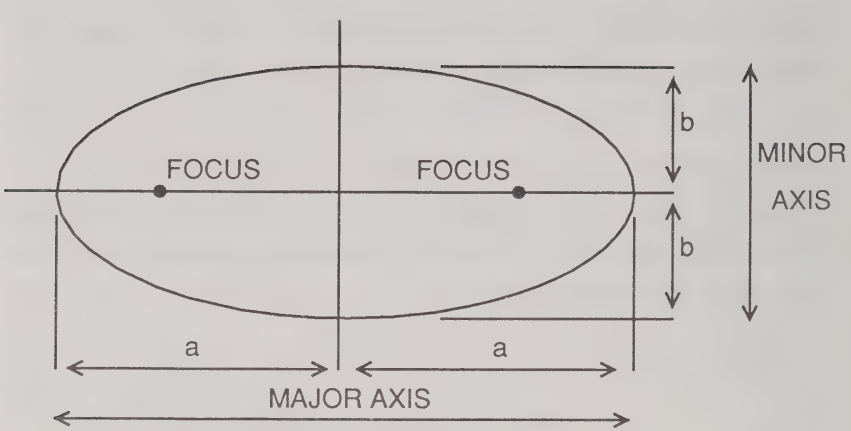


Fig 1

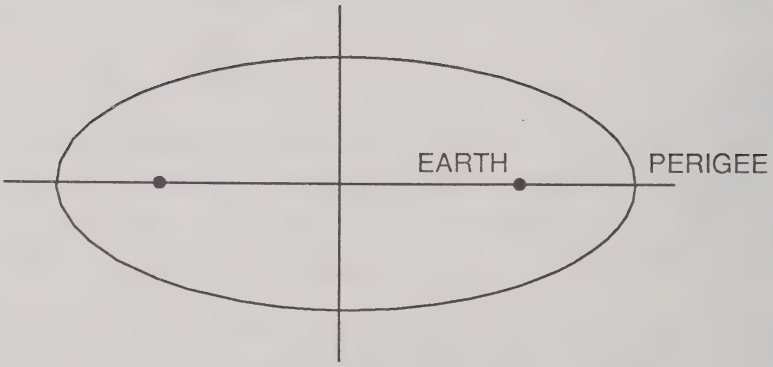
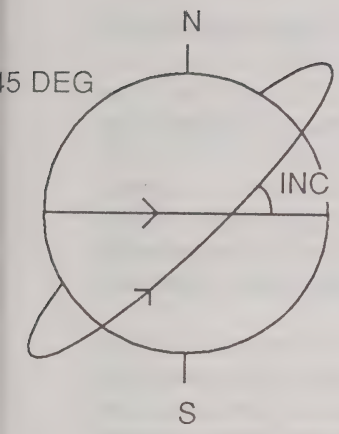
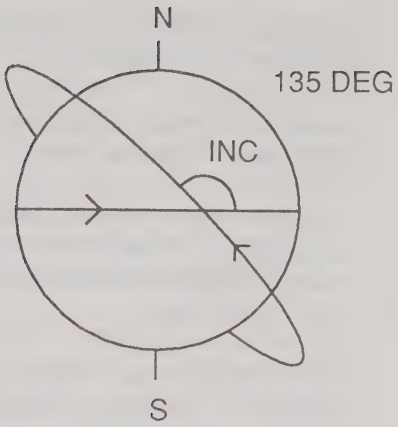


Fig 2


N
45 DEG
INC
S


N
135 DEG
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S

Fig 4

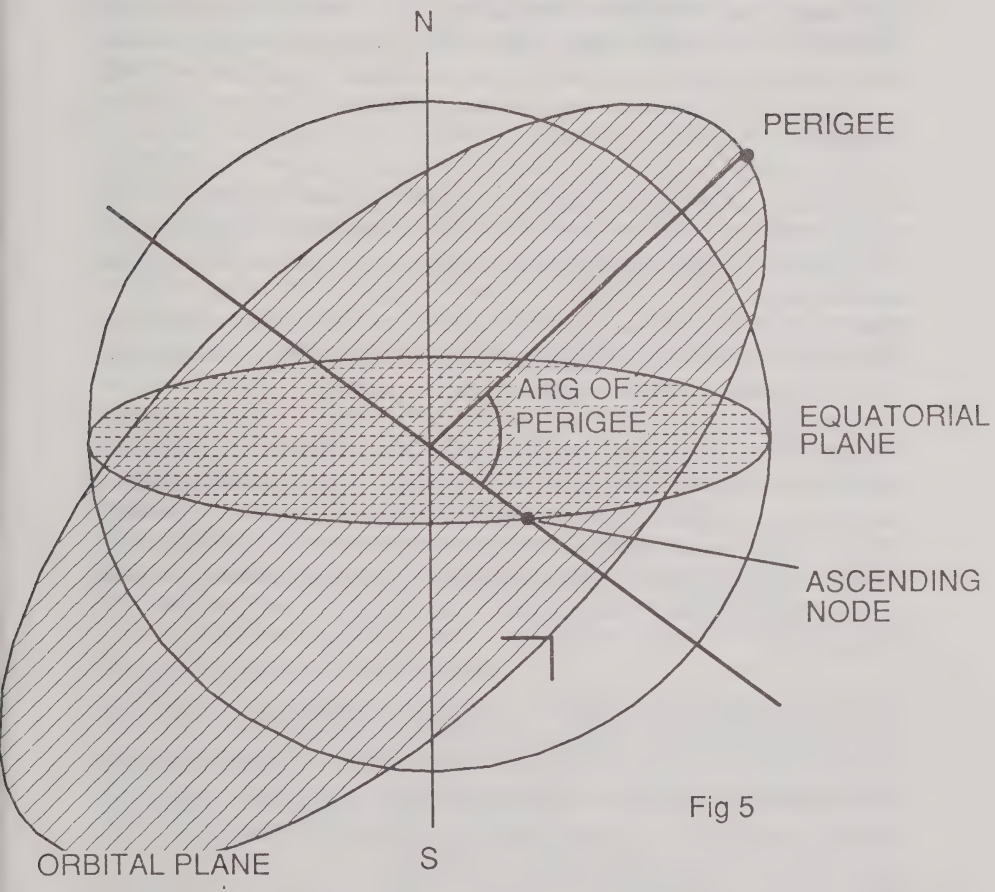
N
PERIGEE
ARG OF
PERIGEE
EQUATORIAL
PLANE
ASCENDING
NODE
ORBITAL PLANE
S

Fig 5

SATELLITE MEASUREMENTS ON SOLID GROUND
by Helen Gavaghan

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We can learn a lot about the earth's environmental processes going on at ground level from satellite observations of the earth's electromagnetic radiation. But first you need a terrestrial yardstick. Helen Gavaghan.

As the Kansas Prairie dried out in this year's summer sun, biologists, physicists, atmospheric chemists and meteorologists measured pretty well everything there was to measure. Some 120 scientists, technicians and pilots from around the world moved into the prairie during July and early August. Last month, they packed up and left after the most intensive effort ever to collect data that will help researchers to interpret information gathered by remote sensing satellites

Biologists classified vegetation and monitored how the rate of evaporation of water from plants changes as the summer progressed. Other groups characterised the soil and its varying water content.
Sophisticated instruments on the ground, on aircraft and on a helicopter collected information about the atmosphere and the electromagnetic radiation emitted from the surface.
Satellites from the U.S., the Soviet Union and France gathered images of the radiation emitted from the area from where the scientists were working. The five weeks of field work, costing $1 million formed part of a $15 million exercise. Led by NASA, the work is part of the U.S.'s contribution to the International Satellite Land-Surface Climatology Project (ISLSCP). The project was formed in 1982 under the auspices of the United Nations Environment Programme.

The overall goal of the ISLSCP is two link to important disciplines, remote sensing from satellites and mathematical modelling of the climate. Both are tools with which scientists can improve their understanding of environmental processes. Concern about how human activity affects the environment on a global scale lends urgency to these evolving areas of research.

To provide a true representation of the environment, one gigantic computer model would simulate the atmosphere, the water cycle, sandstorms, plant growth, ocean currents, ice melting, and geological processes such as uplift of mountains and the interactions between these processes and others. The model would show how changes in one component influences the others. And the model would do all of this on a detailed regional scale. In theory, governments could then respond to the model's forecast and formulate intelligent policy to accommodate environmental change.

Such a "supermodel" does not exist. Even if it did, the most powerful supercomputer could not hold and manipulate such a mathematical monolith. Slowly, though scientists are building models that simulate the interactions between two or three environmental processes. The ISLSCP is concerned with interactions between the surface of the land and the atmosphere and how those interactions change the climate.

Since land and atmosphere stretch around the world, the models of interactions between the two must be global, and data must be collected world wide. Satellites offer the only way of gathering information about the earth's surface on a global scale every few days. Unfortunately, the measurements that satellites make-the brightness of electromagnetic radiation at difference frequencies-are of limited value in their raw state. Scientists must infer the information they need to feed into their climate models from the satellite readings.

A specific goal of the ISLSCP is to develop ways to deduce from satellite data useful information that scientists can feed into models of the interaction of the surface and the atmosphere.
What, for example, can surface temperature, measured by infrared sensors on satellites, tell modellers about exchanges of water vapour and carbon dioxide between the land and the atmosphere?
These exchanges affect climate, and scientists need to know the rates of exchange for their models.

Further, the modellers need to see how the atmosphere scatters and absorbs radiation as it travels to the satellite. Knowing this, they can begin to correct the satellite reading so that it is a true representation of the radiation emitted at the ground.

Modellers must also consider the nature of satellite images. Each image is made up of a number of "picture elements", pixels.

A pixel represents an average reading of the radiation emitted from a particular area. One pixel in an image from Spot, the French satellite, for example, is 20 meters by 20 meters. Other satellite images are built from much larger pixels. Within the area covered by a pixel, the nature of the surface could change dramatically, from dense to very sparse vegetation, for example. In other words, the average reading in a pixel might conceal a significant variation on the ground. Yet the density of vegetation is one of the most significant factors governing the changes of water vapour and carbon dioxide between land and atmosphere. The masked vegetation could lead researchers to feed into their models of the climate incorrectly inferred readings of the rates of exchanges of water vapour.

To solve these problems, ISLSCP plans intensive field campaigns. The work in Kansas this summer, together with a similar effort in the same place in 1987, constitute FIFE, the first ISLSCP field experiment. It will serve as an example for future field campaigns.

During FIFE, scientists made measurements of the land at all scales (see diagram) so that they could relate average satellite readings to what is really happening within a pixel. These readings also allow researchers to check readings deduced from satellite data against real readings taking on the ground. Simultaneously, the scientists studied the atmosphere to improve their understanding of how it interacts with the land and to correct satellite data.

The experiment took place over an area of 15 kilometres square; small enough for scientists to saturate parts of the surface with ground based instruments, yet large enough to incorporate several pictures of a satellites image.

NASA took a conservative approach to the field experiment, because it was the first of its type. First the researchers looked for grassland, because it is harder to take measurements over forest than over grass.
The agency intends to use the experience it has gained to conduct a similar field experiment in a forest in Canada in 1993. Secondly, the agency wanted to put instruments on relatively smooth terrain, and in an area of similar vegetation to prevent already complicated measurements becoming even more complex.

Once the site was selected, the scientists set about designing their experiments.

First, they wanted to measure the radiation from the sun hitting the surface and then the radiation reflected by the surface (radiometer data). Secondly they wanted to make "flux measurements", to determine the rate of exchange of water vapour, heat and carbon dioxide between the surface and the atmosphere. The aim was to learn how to infer correct flux measurements from a satellite's radiometric data.

Within the 15 kilometres square site, the scientists set up their "supersites". These were heavily laden with instruments for measuring leaf physiology, soil characteristics and radiation and fluxes over meters in the immediate area. At one of these, Betty Walter Shea was characterising the optical properties of every type of grass she could find. She measured how much visible and infrared light individual leaves reflected and transmitted. At the same time, instruments a few metres off the ground measured the reflected light averaged over the meter or so they could observe. This gives a reading of the vegetation canopy. At different altitudes, from 750 to 25,000 feet, instruments on the helicopter and aircraft measured average reflectance over larger and larger areas. The researchers will compare these readings to see whether the aggregates of the readings at different scales correlate with the averages of a satellites pixel.

Satellite data came from six spacecraft: two belonging to the U.S's National Oceanic and Atmospheric Administration, Landsat and Goes (also American), the French satellite Spot and a Soviet satellite. The Soviet Union was not involved with the work in 1987, but since then it has assiduously courted NASA. Collaboration with the USSR allows other scientists to asses the quality of data that Soviet scientists have already published.

Other readings at the level of the individual leaf include measurements of how leaves release and retain the water, in terms of stomatal resistance and the water potential. The change in the relative humidity around a plant isolated in a chamber shows how much water is released through the stomata, and so the stomatal resistance. Water potential is measured by putting the leaf in a chamber with compressed nitrogen, and, recording at what pressure water is forced out of the leaf. Again, the idea is to compare how these readings, aggregated oven a given area, compare with the average readings inferred from satellites.

Each supersite had instruments to record the flow of carbon dioxide and water vapour. (the work in 1987 established the prevailing wind direction and the best way to orient the instruments). Some instruments were accurate to parts per billion so when they were recording, people and cars kept away to avoid disturbing measurements of carbon dioxide. Instruments on aircraft repeated the flux measurements, again recording a reading averaged over an area larger than that measured on the ground, but smaller than that covered by a satellite pixel.

To fully understand the fluxes and their effect on climate, the scientists needed a picture of the "boundary layer". This is the region of the atmosphere made turbulent by the heat and water vapour given off by the surface. The boundary layer stretches for about 1500 metres above the surface of the Earth, although the depth varies with time of day- its narrow just before dawn. As the sun heats the air, the boundary layer expands. Above the boundary layer, the air flows more smoothly. The most sophisticated instrument recording the happening inside the boundary layer was "lidar", laser radar. The technique is not new, but Ed Eloranta, a meteorologist at the university of Wisconsin, has developed laser radar to a fine art. The lidar, mounted on a van parked at the centre of the site, scanned a volume of the atmosphere from just over the horizon upwards through 30 degrees and sideways through 40 degrees.

The lidar scans vertically upwards firing a pulse of light about 150 centimetres long every half a degree. When the lidar reaches the top of its 30 degree vertical sweep, it steps sideways through half a degree and scans downwards. The instrument repeats this movement until it has swept the full 30 degrees by 40 degree cone. While firing pulses of light, the instrument measures the light scattered back by dust in the atmosphere. The greater the scattering, the more dust is present. For every 7.5 meters that the light travels away from the laser, Eloranta's instrument can measure the amount of light scattered back towards the laser. The readings continue until the light is 15 kilometres from the van.

Rising hot air carries dust and water vapour into the atmosphere, so the result is a detailed three dimensional snapshot of varying temperatures and the associated water vapour and dust. The lidar churns out 2.6 gigabytes of data per day, enough to fill tens of magnetic tapes. However, Eloranta stores his data on optical discs, which is fortunate as there is not a lot of room inside his van.

A computer screen inside the van shows the three dimensional snapshots of the atmosphere as the laser sweeps out its designated volume. The computer can also isolate a horizontal slice through the volume on each successive sweep to give a dynamic picture of the turbulent atmosphere at particular levels.

The most dramatic pictures appear on the screen on the mornings. At that time, the atmosphere has not had time to mix. Clearly defined regions of hot air show up as water evaporates from the surface in the sun. These "thermals" are the mechanism that lifts water vapour, carbon dioxide and dust into the air.

Eloranta says the data will also improve meteorological models. "Typically, we treat the surface of the earth as homogeneous" he said, "but hawks and glider pilots know that it isn't, and that certain areas are better than others for thermals.
We want to know which thermals are associated with particular terrains.

Now that the intensive stage of data collection is over months of analysis begin. The scientists collected what they wanted, making their measurements as the Prairie dried out. In 1987 the weather did not cooperate, and the researchers did not see this dry down.

NASA's Goddard Space Flight Centre is responsible for supervising the collection and collation of data. Once the scientists have chewed over their reading, they will report there results to the ISLSCP's steering committee. Others groups collecting data in Europe will do the same. Researchers will then be able to feed information from the ISLCSCP into their models of the climate and the design of systems for observing the Earth. Most important, the information will improve the value of data gathered by satellites. Eventually, the results of FIFE may take their place in a giant model of all the earth's processes.

Some Random notes on Meteor Spacecraft
by Geoff Perry, The Kettering Group

Les Currington's "The Russian Satellite Scene" and letters from Lawrence Harris in the RIG Newsletter No 19 have prompted me to set down in detail events connected with the early transmissions from 1989-86A, the third Meteor 3 spacecraft. They are presented as recorded in my notes of telephone conversions, my log of monitoring satellite transmissions (in which all times are given in UT), and various publications in order that RIG members may gain some inkling of how the Kettering Group operates and endeavours to ensure that credit is attributed correctly.

25 Oct 89

2228 BST Call from the Rev James Brown, Porthcawl. 137.85 MHz - not Meteor 3-2 => new Meteor 3. 240 (sic) line min^{-1} infra-red low el to E. Told him it would be round again in a couple of hours ! He is leaving for London tomorrow 09.45. Will see Les Currington. (suggested he watched All Blacks v Neath on TV-he told me that All Blacks had won but I stopped him divulging the score).[Ref T1]

The short duration of the pass implied a low elevation and, even without James's, hint, a two hour wait would, if the transmitter was not turned off, produce further signals for a longer duration if his pass had been out to the east. At this time of night the transmissions would, almost certainly been infra-red and, despite the unlikely 240 lines min^{-1} I had noted down, it seemed reasonable to suppose that we were dealing with a Meteor 3 rather than a Meteor 2 (which transmit slow infra-red imagery at 20 lines per min^{-1})

AOS 120 line min^{-1} infra red? 137.845 MHz 2253:48.
LOS 2312:12

26 Oct 89

0007 BST Called Mrs Zehr in the USA. Tell Grant their is a new Meteor 3 and I am receiving it right now.

Grant subsequently wrote to thank me for the call, enclosing a infra-red example showing the Florida Peninsula and acknowledged James's observation in his summary.[Ref T2]

First reception of signals from this spacecraft was by the Reverend James Brown, an observer in the British Isles who heard signals during one of the first orbits.

The 112 min interval between mid-pass times gave added confidence in the Meteor 3 identification.

From my location in Bude it is possible to hear signals from Meteor 3 spacecraft on ten consecutive passes with a gap of nearly 7 hours between the last pass, southbound to the west, of one group and the first pass, north bound to the east, of the next group of passes. There would be a very good chance of more signals before breakfast.

AOS 137.845 weak 0635. LOS 0640:25.

0735 BST Called Kay Currington. Tell Les there is a new Meteor 3 on 137.85 MHz right now.

0835 BST Call from Les Currington. Had the Meteor. Told him about James.

AOS 137.845MHz 0823:30. Spwow 0831. Sp strong on re-tuning 0836:10: LOS 0839:06. (Mir voice 0831 on re-tuning to LOS 0836.)

0928 BST (Inquiry to ascertain if there had been a TASS announcement) Was there a new Meteor 3 ? Yes, yesterday.[Ref T3]

A Meteor 3 Meteorological satellite was launched in the Soviet Union on the 25th October by a Tsyklon carrier rocket.

AOS 137.845 MHz line min^{-1} infra-red 1013:30. change to visible 1017:21. LOS 1033:04.

These mode-changes occur when the sub-satellite point crosses the terminator and the difference between consecutive mode-changes gives a very good approximation to the orbital period.

AOS 137.845 MHz line min^{-1} infra red 1204:08. Changed to visible 1206:48.
Spwow 1210:15. Tine elapsing between mod changes = 109m 27s +/- 2s = 109.45 +/- 0.03 min.

1330 BST Called Peter Wakelin. Home from the falklands. Told him

about the new Meteor.

1358 BST Call from Max White. Elset for new Meteor (suggested launch at 2135 Z, 24 Oct '89 but earlier elsets received subsequently indicate 2140 Z). He had it around 0100 Z, on returning home from observing with the Hewitt camera at RGO, and again at breakfast time. He will notify Len Maxim (New Zealand) and Greg Roberts (Cape Town).

1452 BST Called Torquay Technical College. Left message for John Murray.

1920 BST from Les Currington. Had 08.. pass. Mode change. Told him I did not spot that but did so on the next two passes.

27 Oct '89

1840 BST Call from Jim Graham, Aerospace Daily. Gave him details about Meteor 3-3. These were subsequently published ref Ref T4

> It was first detected Oct 25 by the Rev James Brown of Porthcawl, who received infra-red images from it transmitting at 137.845 MHz.

Thus it would appear that, inadvertently, Mr Harris has not received equal credit for his observations and for that I offer my apologies.

Ref T1:
A call from the Rev Brown at 1005 on 2 Jan 90 in response to a query of mine to les Currington, revealed that he had received the signals at 2114 Z and that Mr Harris had called him prior to his call to me. He did not inform me of this at the time.

Ref T2:
Zehr, G. Summary of Soviet Meteorological satellite activity, 6 Nov 1989

Ref T3:
TASS in Russian for abroad 0903 and in English 0938 UT 25 Oct '89. The launch did not occur on 25th October if reckoned in Moscow Time.

Ref T4
Aerospace Daily, 152, 30 Oct 1989, p.163

For sometime I have been intrigued by a phenomenon for which I see no logical explanation - this concerns the daily time differences of corresponding passes for the Meteor 2 and Meteor 3 series spacecraft. I am sure that RIG members are aware of the phenomena and perhaps someone can throw some light on the subject? The orbital periods chosen for these series of approximately 104.1 and 109.4 min produce daily time differences of +17.4 and -17.8 min respectively. The precise values for the currently operational satellites are given in table 1.

Table 1. Daily time differences for operational Meteor satellites

Meteor 2-16	+17.92 min	Meteor 3-2	-17.71 min
Meteor 2-17	+17.20 min	Meteor 3-3	-16.59 min
Meteor 2-18	+17.57 min		

I find it strange that these positive and negative time differences are so nearly equal and feel that there must be a good reason for this rather than pure coincidence. I did expect to discover that it was a consequence of a ground-track repeat constraint but have found no evidence that this is so. It had not escaped my notice that 120/7 = 17.14. Could it be that these orbital periods are chosen so that all passes occur approximately two hours earlier on a weekly basis? What advantages would that offer? How do these times of passes for the different operational spacecraft fit together? The 60 degree plane-spacings in the constellations dictate that spacecraft follow each other at approximately four hour intervals, so do monitoring schedules for different spacecraft replicate a fundamental schedule on a fortnightly basis? RIG members who routinely produce imagery (and knowing that I listen only, and irregularly at that) will probably be chuckling over these musings, being already in possession of the answers based on their own experience!

With the cessation of APT on 137.4 MHz in 1987 it was not unreasonable to presume that the active life of Meteor 3-1 had ended. However, when Meteor 3-2 was launched in 1988 it was placed in an orbital plane 60 degrees away from that of Meteor 3-1.

When Meteor 3-3 was launched last year it did not occupy the same plane as Meteor 3-1 but was placed 60 degrees away from Meteor 3-3 and 120 degrees away from Meteor 3-1. This raises the possibility that some systems of Meteor 3-1 could still be active employing higher frequencies and that a three satellite constellation is operational.

The right Ascensions of the ascending nodes of the Meteor 3 satellites and the operational Meteor 2 satellites are given in the following table:

Table 2. Right Ascensions of Ascending Nodes

Meteor 3-3	346.5 degrees	Meteor 2-18	13.6 degrees
Meteor 3-2	46.3 degrees	Meteor 2-16	74.6 degrees
Meteor 3-1	106.4 degrees	Meteor 2-17	135.2 degrees

The approximate 60 degrees plane-spacings in each constellation are immediately apparent.

Some details of the Meteor 3 series spacecraft were disclosed at the EARTH MISSION 20000 Conference, held at the Queen Elizabeth 11 Conference Centre, Westminster, on Thursday, 7th December 1989. The Deputy Director, Dr Yuriy V Trifonov, presented a paper outlining the work of VNIIEM, the All-Union Science-Research Institute of Electromechanics. The vu graph of the design and instrumentation of Meteor 3 spacecraft is shown opposite.

OZON-M is a multi channel UV spectrometer, TOMS is a device for mapping the ozone layer and ERBE is a device for determining the radiation balance. The RMK radiation metering complex, which registers the flow-densities of protons and electrons is not indicated.

Amongst details given for the spacecraft on another vu graph were a spacecraft mass of 2150 kg, of which the informative instrumentation comprised 700 kg, a service life of two years and an orientation accuracy of 0.5 degrees. Further data relating to the instrumentation is given in the following table.

NOAA-11 SEP 1989 1800-1900 GMT VIS
220K

NOAA-11 01/04/89 ADS 02:36:11 AUCKLAND TAPE

NOAA '10' PERIOD 101.21977749 MINS INCR 25.30543018 DEG

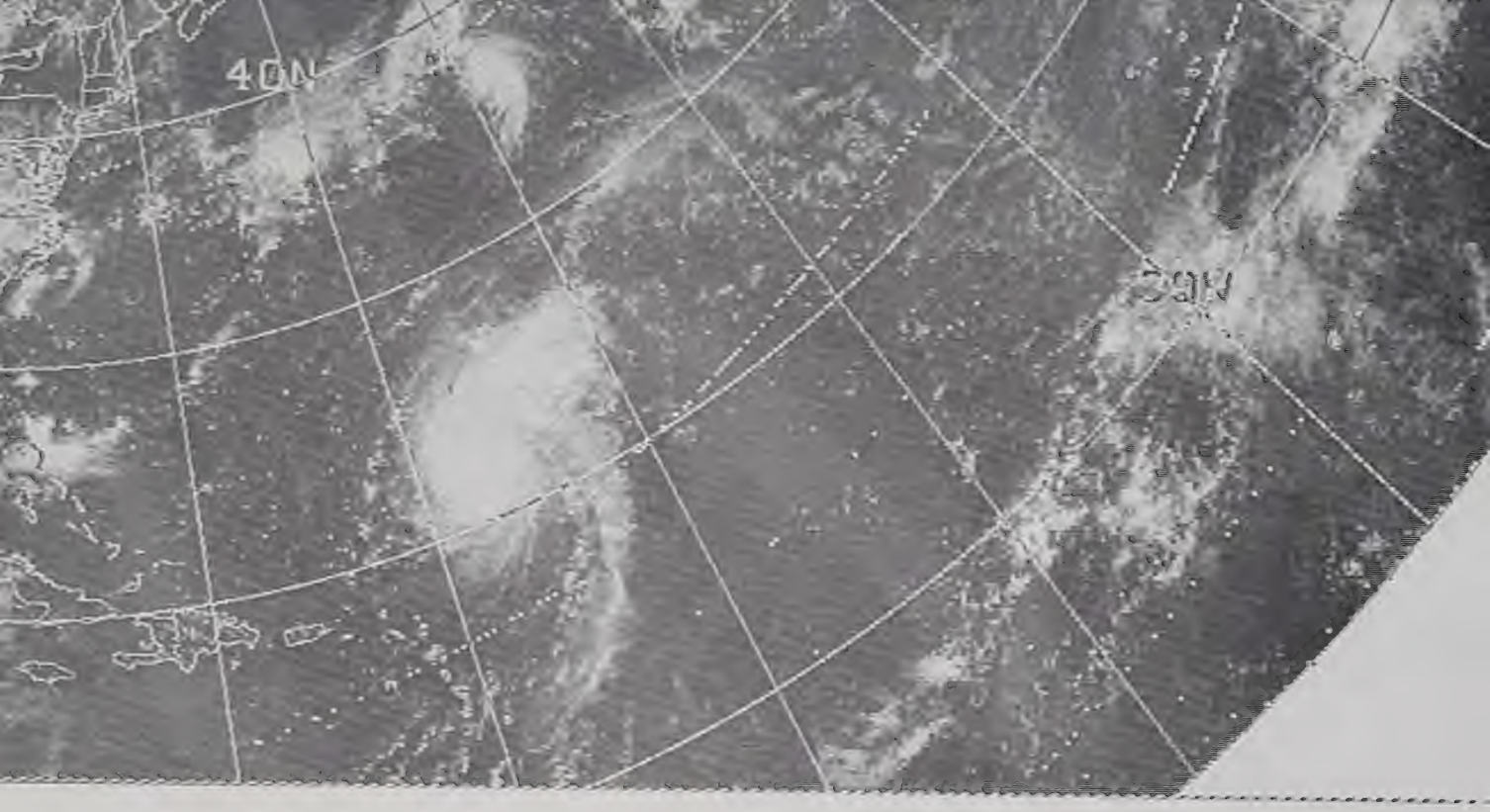
1/04 181 07:32	30/04 344 18:23	29/05 330 17:25	28/06 183 07:39
1/04 333 17:39	1/05 186 07:53	29/05 355 19:07	28/06 335 17:46
2/04 352 18:57	1/05 338 18:00	30/05 349 18:44	29/06 330 17:23
3/04 347 18:35	2/05 181 07:30	31/05 344 18:21	29/06 355 19:05
4/04 189 08:04	2/05 333 17:37	1/06 186 07:51	30/06 349 18:42
4/04 341 18:12	3/05 352 18:55	1/06 338 17:58	1/07 343 18:19
5/04 183 07:41	4/05 346 18:32	2/06 332 17:35	2/07 186 07:48
5/04 335 17:49	5/05 189 08:02	3/06 352 18:53	2/07 338 17:56
6/04 330 17:26	5/05 341 18:10	4/06 346 18:30	3/07 332 17:33
6/04 355 19:07	6/05 183 07:39	5/06 189 08:00	4/07 352 18:51
7/04 349 18:44	6/05 335 17:47	5/06 340 18:07	5/07 346 18:28
8/04 343 18:21	7/05 355 19:05	6/06 183 07:37	6/07 188 07:58
9/04 186 07:51	8/05 349 18:42	6/06 335 17:45	6/07 340 18:05
9/04 338 17:58	9/05 343 18:19	7/06 354 19:03	7/07 183 07:35
10/04 332 17:35	10/05 186 07:49	8/06 349 18:40	7/07 334 17:42
11/04 352 18:54	10/05 337 17:56	9/06 343 18:17	8/07 354 19:01
12/04 346 18:31	11/05 332 17:33	10/06 185 07:47	9/07 348 18:38
13/04 188 08:00	12/05 351 18:51	10/06 337 17:54	10/07 342 18:15
13/04 340 18:08	13/05 346 18:29	11/06 331 17:31	11/07 185 07:45
14/04 183 07:37	14/05 188 07:58	12/06 351 18:49	11/07 337 17:52
14/04 334 17:45	14/05 340 18:06	13/06 345 18:26	12/07 331 17:29
15/04 354 19:03	15/05 182 07:35	14/06 188 07:56	13/07 351 18:47
16/04 348 18:40	15/05 334 17:43	14/06 339 18:04	14/07 345 18:24
17/04 342 18:17	16/05 354 19:01	15/06 182 07:33	15/07 187 07:54
18/04 185 07:47	17/05 348 18:38	15/06 334 17:41	15/07 339 18:01
18/04 337 17:54	18/05 190 08:08	16/06 353 18:59	16/07 182 07:31
19/04 331 17:31	18/05 342 18:15	17/06 348 18:36	16/07 333 17:39
20/04 351 18:50	19/05 185 07:45	18/06 190 08:06	17/07 353 18:57
21/04 345 18:27	19/05 336 17:52	18/06 342 18:13	18/07 347 18:34
22/04 187 07:57	20/05 331 17:29	19/06 184 07:43	19/07 190 08:04
22/04 339 18:04	21/05 350 18:48	19/06 336 17:50	19/07 342 18:11
23/04 182 07:34	22/05 345 18:25	20/06 330 17:27	20/07 184 07:41
23/04 333 17:41	23/05 187 07:54	21/06 350 18:46	20/07 336 17:48
24/04 353 18:59	23/05 339 18:02	22/06 344 18:23	21/07 330 17:25
25/04 347 18:36	24/05 181 07:32	23/06 187 07:52	21/07 355 19:06
26/04 190 08:06	24/05 333 17:39	23/06 339 18:00	22/07 350 18:43
26/04 342 18:13	25/05 353 18:57	24/06 181 07:29	23/07 344 18:21
27/04 184 07:43	26/05 347 18:34	24/06 333 17:37	24/07 186 07:50
27/04 336 17:50	27/05 189 08:04	25/06 352 18:56	24/07 338 17:58
28/04 330 17:28	27/05 341 18:11	26/06 347 18:32	25/07 181 07:27
28/04 355 19:09	28/05 184 07:41	27/06 189 08:02	25/07 333 17:35
29/04 350 18:46	28/05 336 17:48	27/06 341 18:09	26/07 352 18:53

All morning passes are southbound, evening passes are northbound.
Frequency 137.50MHz. INCRement is degrees change per orbit.

NOAA '11' PERIOD 102.0715181 MINS INCR 25.516825398 DEG

1/04 345 13:02	30/04 188 02:37	29/05 185 02:24	28/06 331 12:13
2/04 189 02:39	30/04 341 12:49	29/05 338 12:37	29/06 354 13:44
2/04 342 12:51	1/05 185 02:26	30/05 182 02:13	30/06 351 13:33
3/04 186 02:28	1/05 339 12:38	30/05 335 12:26	1/07 349 13:22
3/04 339 12:40	2/05 183 02:15	31/05 332 12:15	2/07 346 13:11
4/04 184 02:17	2/05 336 12:27	1/06 355 13:46	3/07 190 02:47
4/04 337 12:29	3/05 333 12:16	2/06 352 13:35	3/07 343 13:00
5/04 181 02:06	4/05 330 12:05	3/06 349 13:24	4/07 187 02:36
5/04 334 12:18	5/05 353 13:36	4/06 347 13:13	4/07 340 12:49
6/04 331 12:07	6/05 350 13:25	5/06 344 13:02	5/07 184 02:25
7/04 354 13:38	7/05 348 13:14	6/06 188 02:38	5/07 338 12:38
8/04 351 13:27	8/05 345 13:03	6/06 341 12:51	6/07 182 02:14
9/04 348 13:16	9/05 189 02:40	7/06 185 02:27	6/07 335 12:27
10/04 346 13:05	9/05 342 12:52	7/06 338 12:40	7/07 332 12:16
11/04 190 02:42	10/05 186 02:29	8/06 182 02:16	8/07 355 13:47
11/04 343 12:54	10/05 339 12:41	8/06 336 12:29	9/07 352 13:36
12/04 187 02:31	11/05 183 02:18	9/06 333 12:18	10/07 349 13:25
12/04 340 12:43	11/05 336 12:30	10/06 330 12:07	11/07 346 13:14
13/04 184 02:20	12/05 181 02:07	11/06 353 13:38	12/07 344 13:03
13/04 337 12:32	12/05 334 12:19	12/06 350 13:27	13/07 188 02:40
14/04 181 02:09	13/05 331 12:08	13/06 347 13:16	13/07 341 12:52
14/04 335 12:21	14/05 354 13:39	14/06 345 13:05	14/07 185 02:29
15/04 332 12:10	15/05 351 13:28	15/06 189 02:41	14/07 338 12:41
16/04 355 13:41	16/05 348 13:17	15/06 342 12:54	15/07 182 02:18
17/04 352 13:30	17/05 345 13:06	16/06 186 02:30	15/07 335 12:30
18/04 349 13:19	18/05 190 02:43	16/06 339 12:43	16/07 333 12:19
19/04 346 13:08	18/05 343 12:55	17/06 183 02:19	17/07 330 12:08
20/04 190 02:45	19/05 187 02:32	17/06 336 12:32	17/07 355 13:50
20/04 343 12:57	19/05 340 12:44	18/06 333 12:21	18/07 353 13:39
21/04 188 02:34	20/05 184 02:21	19/06 331 12:10	19/07 350 13:28
21/04 341 12:46	20/05 337 12:33	20/06 353 13:41	20/07 347 13:17
22/04 185 02:23	21/05 181 02:10	21/06 351 13:30	21/07 344 13:06
22/04 338 12:35	21/05 334 12:22	22/06 348 13:19	22/07 188 02:43
23/04 182 02:12	22/05 332 12:11	23/06 345 13:08	22/07 342 12:55
23/04 335 12:24	23/05 354 13:43	24/06 189 02:44	23/07 186 02:32
24/04 332 12:13	24/05 352 13:32	24/06 342 12:57	23/07 339 12:44
25/04 330 12:02	25/05 349 13:21	25/06 187 02:33	24/07 183 02:21
25/04 355 13:44	26/05 346 13:10	25/06 340 12:46	24/07 336 12:33
26/04 352 13:33	27/05 190 02:46	26/06 184 02:22	25/07 333 12:22
27/04 350 13:22	27/05 343 12:59	26/06 337 12:35	26/07 330 12:11
28/04 347 13:11	28/05 187 02:35	27/06 181 02:11	27/07 353 13:42
29/04 344 13:00	28/05 340 12:48	27/06 334 12:24	28/07 350 13:31

All morning passes are southbound, afternoon passes are northbound.
Frequency 137.62MHz. INCRement is degrees change per orbit.


40N
30W

Met 3 satellite Diagram

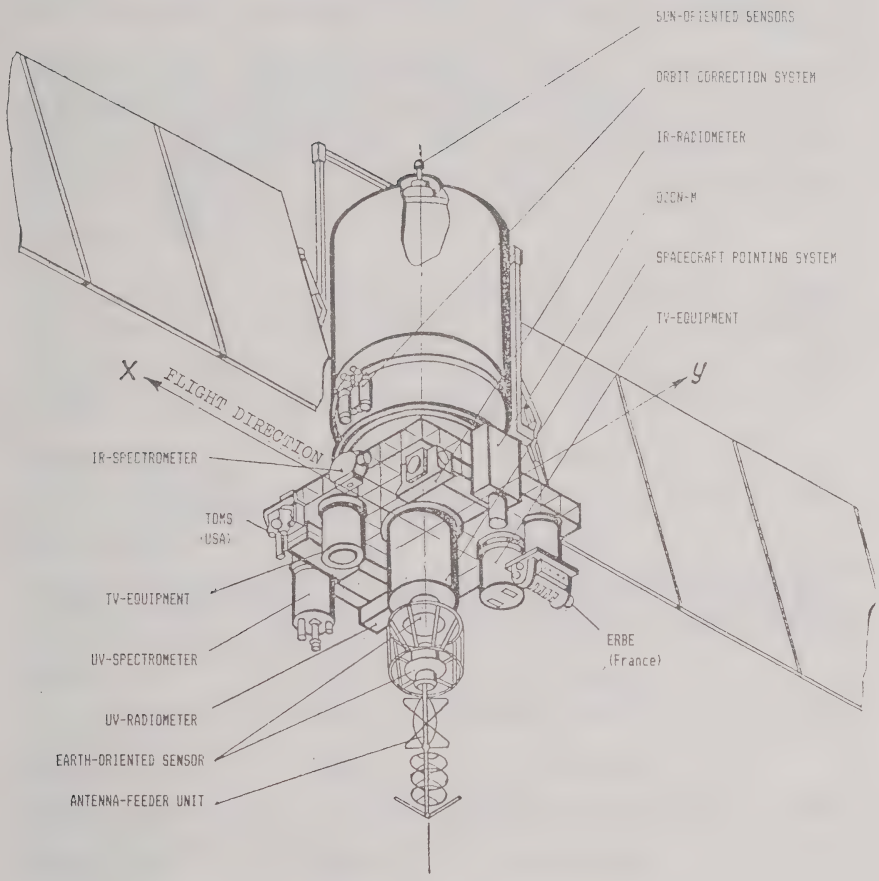


DIAGRAM OF METEOR-3 SPACECRAFT SHOWN BY Yu TRIFONOV

AT "EARTH MISSION 2000"

Table 3. Meteor 3 Spacecraft Instrumentation Data

TV-equipment	High-resolution radiometer	IR-spectrometer	UV-spectrometer for backscatter	OZON-M	TOMS	ERBE
Spectral bands :- (microns)						
05.-0.8	10.5-12.5	9.4-19.68 in 10 bands	0.25-0.38 in 8 bands	0.25-0.29 0.37-0.39 0.60-0.64 0.99-1.03	0.3125 0.3175 0.3313 0.3398 0.3600 0.3800	0.5-0.7 0.2-4.0 0.2-50.0 10.5-12.5
Ground resolution (km)						
0.7x1.4	3.0x3.0	42	3-5 in altitude	2 in altitude	47 x 47in nadir 62 x 62 over whole frame	50 in nadir
Data rate:						
15.6 Mbps 960 kbps	15.6 Mbps 960 kbps	15.6 Mbps 960 kbps	15.6 Mbps 960 kbps	15.6 Mbps 960 kbps	4Mb/day	4Mb/day

THE RUSSIAN SATELLITE SCENE
by Les Currington, G8LOK

During the last few months of Soviet Weather Watch we have seen very little activity; but we watch with keen anticipation in the expectation of a new launch, especially as the new OKEAN was long overdue.

Well our waiting was over when on the 25 Oct 89 at 21.14 Hrs the ever watchful James Brown heard what appeared to be a new Meteor giving IR scan; on confirming with Geoff Perry it was established that a new Meteor, 3-03 had been launched. Since then excellent pictures have been seen in IR; not until early January will we be able to see a visible picture in the U.K.

It probably would be wise to mention that while compiling the report on the Meteors, comments made refer to the activity at the time of writing. in this case 30 Nov 89; by the time RIG is published all Meteors would be in an orbital plane approximately two hours earlier.

Okean **88-56A** **137.4MHz**
This Oceanographic Satellite has not been heard for some considerable time until James Brown heard a short pass in September.

Meteor 2/16 **87-68A** **137.4MHz**
During the ascending morning pass of 29 Nov 89 excellent pictures were received showing the recent fall of snow in eastern Europe, also thick fog covering a large part of Italy.

Meteor 2/17 **88-05** **137.30 MHz**
Now in a early morning pass and not transmitting due to lack of solar illumination.

Meteor 2/18 **89-18** **137.85 MHz**
Meteor 2/18 continues to give excellent pictures on a mid morning near overhead ascending pass.

Meteor 3/02 **88-64A** **137.30 MHz**
Not heard for several weeks.

Meteor 3/03 **89-86A** **137.85 MHz**
Transmitting excellent IR.

LATE NEWS - NEW OKEAN LAUNCH

Wed 28th Feb 1990

A new OKEAN Oceanographic satellite has been launched. At 11:49 on 2/3/90 I recorded a visible pass covering the Gulf of Bothnia. On Saturday 3/3/90 at 12:18 a recorded picture was received covering an area between Antartica and Australia. Keplers on next page.

KEPLER ELEMENTS
provided by Max White - Kettering Group

	NOAA 9	MET 2-17	MET 3-03
	137.62 MHz	137.30 MHz	137.85 MHz
	84-123 A	88-05 A	89-86 A
EPOCH OF DATA	90067.89395460	90066.42902540	90067.62237586
ACCELERATION	0.00000760	0.00000143	0.00000067
REV NO	26982	10610	1772 ???
INCLINATION	99.1656	82.5408	82.5539
R. A. NODE	65.4125	71.3536	288.9382
ECCENTRICITY	0.0014365	0.0015087	0.0014972
ARG OF PERIGEE	292.2732	251.7138	218.7203
MEAN ANOMALY	67.6919	108.2378	141.2827
MEAN MOTION	14.12468645	13.84298266	13.15853385

	MET 3-02	NOAA 11	NOAA 10
	137.3 MHz	137.62 MHz	137.50 MHz
	88-64 A	88-89 A	86-73 A
EPOCH OF DATA	90067.29313842	90067.86775287	90067.90743654
ACCELERATION	0.00000391	0.00000442	0.00000593
REV NO	7767	7481	18034
INCLINATION	82.5422	98.9709	98.6091
R. A. NODE	348.8070	16.1281	98.0597
ECCENTRICITY	0.0018021	0.0011398	0.0013474
ARG OF PERIGEE	201.3835	202.5957	197.2694
MEAN ANOMALY	158.5611	157.4717	162.8029
MEAN MOTION	13.16879386	14.11478246	14.23487330

	MET 2-18	MET 2-16	OKEAN 2
	137.3 MHz	137.4 MHz	137.4 MHz
	89-18	87-68 A	90-18 A
EPOCH OF DATA	90067.09705581	90066.87022473	90070.91816171
ACCELERATION	0.00000189	0.00000219	0.00002014
REV NO	5158	12897	175
INCLINATION	82.5295	82.5569	82.5300
R. A. NODE	309.0202	10.5909	187.2542
ECCENTRICITY	0.0013231	0.0012425	0.0019161
ARG OF PERIGEE	292.5327	169.8523	226.3142
MEAN ANOMALY	67.4430	190.2896	133.6380
MEAN MOTION	13.83944183	13.83607451	14.72688125

Reference Orbits for Russian Satellites supplied by Dick Boardman

These are the times of north going equator crossing (in GMT) and longitudes (in degrees west) for four Russian satellites.
They are given at weekly intervals together with the period and the change in longitude per orbit.

MET 2-17 137.30 MHz
period 104.091 minutes increment 26.09 degrees

23 DEC 03:00 005	30 DEC 01:32 356	06 JAN 01:49 012
13 JAN 00:21 003	20 JAN 00:38 019	26 JAN 23:09 010
02 FEB 21:42 000	09 FEB 21:58 017	16 FEB 20:31 007
23 FEB 19:03 358	02 MAR 19:20 014	09 MAR 17:52 005
16 MAR 16:25 355	23 MAR 16:40 012	30 MAR 15:13 002
06 APR 15:29 019	13 APR 14:02 009	20 APR 12:34 000

MET 2-18 137.85 MHz
period 104.122 minutes increment 20.26 degrees

23 DEC 18:35 002	30 DEC 18:54 019	06 JAN 17:29 010
13 JAN 16:04 001	20 JAN 16:23 019	27 JAN 14:58 010
03 FEB 13:33 001	10 FEB 13:51 018	17 FEB 12:26 009
24 FEB 11:01 000	03 MAR 11:21 017	10 MAR 09:56 008
17 MAR 08:31 000	24 MAR 08:50 017	30 MAR 07:25 008
07 APR 05:59 359	14 APR 06:18 016	21 APR 04:53 007

MET 3-02 137.30 MHz
Period 109.407 minutes increment 27.46 degrees

23 DEC 21:52 018	30 DEC 19:49 359	06 JAN 19:34 007
13 JAN 19:20 015	20 JAN 17:15 356	27 JAN 17:00 004
03 FEB 16:47 012	10 FEB 16:32 021	17 FEB 14:28 001
24 FEB 14:13 010	03 MAR 13:59 018	10 MAR 11:55 359
17 MAR 11:41 007	24 MAR 11:26 015	31 MAR 09:23 356
07 APR 09:08 004	14 APR 08:54 012	21 APR 08:39 021

MET 3-03 137.85 MHz
Period 109.50 minutes increment 27.46 degrees

23 DEC 17:26 011	30 DEC 17:19 021	06 JAN 15:23 004
13 JAN 15:17 014	20 JAN 13:20 357	27 JAN 13:14 007
03 FEB 13:08 017	10 FEB 11:11 000	17 FEB 11:05 010
24 FEB 10:58 020	03 MAR 09:01 003	10 MAR 08:55 013
17 MAR 06:59 356	24 MAR 06:53 006	31 MAR 06:46 016
07 APR 04:50 359	14 APR 04:44 009	21 APR 04:36 019

HRPT - An ongoing saga by Peter Hayes GM3RAO
Part three..... First catch your satellite.

If you have been following the story so far you will know that I've been attempting to put together a system to receive and display NOAA high resolution pictures along the lines described in a series of articles published by Wireless World (as it was known then) Nov 81 to Jan 82. The digital processing to convert the received data into a form suitable for computer or framestore processing has been generally successful but perhaps predictably, the major problem has proved to be acquiring sufficient signals from the satellite in the first place.

I suggested that if I could resolve the high resolution transmissions from MET 4 then reception from NOAA may be possible. A further (more careful !) reading of the WW article confirmed this.
The antenna gain required depends on the system noise temperature and is express as G/T, and takes into account such things as the signal bandwidth, path loss, etc. The recommended figure for MET 4 is 10.7, and the minimum figure for NOAA is about 4.5. In comparison, the G/T for Meteosat APT is 2.5, so a few extra dBs gain from a larger dish should suffice. Using a "state of the art" head amp with a noise figure of about 0.5 or 0.6 dB (around 50 degrees K), th minimum antenna gain comes out at about 25 dB for NOAA and 30 dB for Meteosat, always assuming that the head amp has sufficient gain to control system noise temperature. The RIG head amp certainly has sufficient gain and hopefully will have low enough noise figure.
Therefore I could resolve MET 4, albeit with some noise, then NOAA should come in loud and clear.

To put the task into some kind of perspective, the transmitted effective radiated power (ERP) from MET 4 is specified as 19 dBW, or about 80 Watts. This is the transmitter power multiplied by the antenna gain and the signal is of course spread over the entire hemisphere as seen from the satellite, so the signal level at the earth's surface is very week to say the least. In comparison the BSB satellite, when (?) programmes begin will have an ERP of about 62 dBW, or something over a Megawatt !!!!!
The on board transmitter runs 110 watts per channel (about 20 dBW) and the other 40 dB or so comes from the antenna, and of course the "foot print" is only a tiny part of the earth's surface.

These figures have now been "revised downwards" by about 3 dB (55 watt transmitted power) because more channels are to be transmitted, and this has aggravated the problems of the "squirrel", but still provides a startling comparison with Meteosat.

The next part of the project therefore was to build a suitable dish. A 2 meter dish still seams a safe bet for NOAA and should pull in some sort of signal from Meteosat. I had 16 heavy gauge steel strips abut 2 " wide and 6 feet long left over from a DIY project, and I bolted then together into the shape of a dish. The idea was to fit aluminium panels, and if the sizes were correct they would form the surface of a 3.5 meter dish, giving plenty of spare gain to over come constructional errors. However just as I was about to make the panels a chance conversation brought news of a locally available 1.8 meter ex-TVRO dish, complete with az/el tripod. This was duly acquired and a design of a suitable feed investigated. A feed for use at Meteosat frequencies is usually made out of a cylinder closed at one end (usually a tin can), with a monopole fitted about a quarter wavelength from the closed end, but like everything else in life there's more to this than meets the eye!

It is sometimes easier to think of feed design in terms of its use as a radiator rather than a receiver. If the feed concentrates the beam over too narrow a angle you may as well use a small dish since only part of its surface is in use. On the other hand if the feed beamwidth is too wide that part of the beam that misses the dish does no useful work other than heating up the landscape. During reception, radiation noise, etc out side the dish area will enter the feed and degrade the system noise temperature. Since the sky is about 70 degrees K at 1.7 GHz and that of the area around the dish may be several hundred degrees it's obviously highly desirable that the feed "sees" only the dish and not its surroundings. Because the radiation pattern of the feed falls off only gradually, it is possible to use the dish to only about 55 % of its potential and most quoted gain figures will take this into account. There are other minor details which can help squeeze another 1 or 2 dB extra gain at best and sometimes this can be the difference between success and failure. NOAA transmits right hand circular polarisation and the feed should take this into account. The feed itself has to be left hand circular and reflection from the dish surface will turn this into right hand.

To illuminate the dish as efficiently as possible, its geometry has to be accurately known. Its useless to pluck some figures out of thin air, perhaps to fit the size of some tin can you fancy using as you will almost certainly not realise the full potential of your dish. The design of the feed depends on the ratio of the distance of the focus from the centre of the dish (focal length, F) to the diameter (D) of the dish. The F/D of the RIG dish is about 0.5 and the currently popular "Sky" dishes are about 0.9. The use of long focal lengths is comparatively new (they are more tolerant of constructional errors and the feed is easier to design), and, in keeping with most older TVRO dishes, my dish has an F/D of about 0.3 requiring a feed with a 10 dB beamwidth of about 150 degrees. Fortunately, the dish used by Dundee University in their PDUS project and detailed in their write up for the ESA was also traditionally designed and its F/D is 0.3333, so I decided to use their figures. After much searching I found a paint tin of nearly the right diameter and only a little short so this was pressed into service (after the contents were decanted!). I soldered a short length of copper wire to the centre pin of an N-type socket and fitted this in the side of the tin. The monopole was carefully cut to length and on its own this arrangement gave recognisable although noisy APT pictures from Met 4. The monopole has to be accurate to less than a millimetre and is a little shorter that it would be in free space.

Fitting this as accurately as possible in front of the dish with pre-amp at the feed produced around 10 dB more signal than the quad loop yagi which was about what I expected. Hopefully I will be able to squeeze a further dB or so out of it yet but the extra 10 will do fine for the moment. Now I was in a position to see if I could get digits from Met 4. I hooked up the demodulator and it locked and produced noisy output but the "eyes" as described in RIG 18 were certainly nothing like 80 % open. Some more work with the soldering iron re-jigged the system for the narrower bandwidth (1MHz instead of 5.7 MHz), and the eyes open a little, but the demodulator lock was a bit touchy. I then tried filtering out the carrier and used it to lock the demodulator, and this was a lot more successful. Now I could fiddle with the IF tuning and the demodulator remain locked.
With care and everything working well I can get tolerable results.

The major drawback of course is that because I made the carrier filter very narrow to get the cleanest signal there is no provision for copying with NOAA Doppler shift which if you remember is about 75 KHz.

Maybe if I have a few dB in hand on NOAA I can afford to replace the carrier filter with, say, a 200 KHz ceramic filter so the carrier will stay in the pass band. The filters to be switched depending on the satellite being used.

Around this time the RSGB published an article in Radcom describing a "simple spectrum analyser" and I side tracked a little to build it.
The spectrum analyser allows you to display a signal on an oscilloscope not as a graph of amplitude against time as on a normal scope but as amplitude against frequency; in other words you can have a band of frequencies spread out across the screen to see if everything is as you fondly imagine it to be. Commercial analysers cost thousands but are virtually mandatory for the professionals.
With my home made effort I found further scope (!) for improvement and so far this has resulted in what I hope is good enough signal for the further processing I would certainly recommend building the spectrum analyser as it will revel all sorts of "funnies" in any RF gear you build up to its limits of around 80 MHz.

Everything worked fine until Met 4 was replaced by Met 3 due to its image problems. The 3dB dips made the system marginal, but at least it seemed good enough for NOAA. The next step was to try it out on NOAA and see what happened. This of course involves tracking the satellite; no mean task and the bigger the dish the more difficult it becomes. Manual tracking is adequate for a proving test but for regular use some automatic system is necessary, probably computer driven. Az/el rotators made for use with the amateur Oscar satellite have a pointing accuracy around 4% which is nowhere good enough for much more than a 1 metre dish.
Other than purchasing a rotator made specifically for steering medium sized dishes I will have to devise some home made system, perhaps made from scrap car gear boxes.

First attempts to acquire the satellite have not been very successful, manual tracking is definitely an acquired skill! Next time I hope to report some success both in pointing the dish accurately and in demodulating the signal. Perhaps by then the RIG head amp kit will have arrived and with a bit of luck and careful tweaking I'll have a cleaner signal. After that, the digital data will have to be hooked up into the framestore and maybe I'll see if its all worth it !!!!!!

The Pager Phenomenon, and other interference problems. Some causes and cures by Peter Hayes, GM3RAO

If you have ever attempted to receive signals from the VHF Polar Orbiter Weather satellites you will almost certainly have come across the "pager Phenomenon" especially if you live in an urban environment. Just as a good picture is coming through, the local pager, taxi service or whatever will come on and the next few lines will be obliterated. Just how much damage is done depends on weather you are using the transmitted 2400 Hz sync or external 2400HZ sync.

However, don't confuse interference with the fading that usually occurs at the start and finish of the pass. This is caused by the direct signal from the satellite being cancelled out by the reflected signal from the earth's surface. As the satellite "rises" the relative phase of the two signal changes, sometimes reinforcing and sometimes cancelling out. It is possible to reduce the severity of the fading by experimenting with the height of the antenna above ground. In my case I found that sitting the antenna on a pole about 8 feet above ground with no near by obstructions gave the same coverage as when it sat on the mast about 30 feet high, but the fading present at 30 feet had disappeared. Every situation will be different, however, if all else fails it is possible to minimise the effect by installing an antenna with a narrow vertical response to reduce the strength of the reflected signal, but you will have to track the satellite.

Interference from other transmitters can have many causes ranging from sheer overload to complex mixing effects and careful study of the systems can pinpoint the likely cause; curing the problem may not be so easy though! Most weather satellite receivers in amateur use offer good overall performance considering the price but generally have not been designed with strong signal performance in mind, especially as pagers are a recent development. It is perhaps a pity that pagers were allocated frequencies so near a weak signal band, but space in the VHF spectrum is at a premium and the allocating authorities are entitled to expect that receivers have an adequate specification for the job they are expected to do; in short, you can't complain if the pager interferes with your satellite reception provided of course the pager isn't putting out spurious radiation or "sproggies" falling in the satellite band.

If you find this to be the case you're fully entitled to complain to the authorities to get it fixed, but make sure you are on solid ground first!!

Assuming that trouble lies in the receiver deficiencies (this is not to decry amateur receivers, full spec receivers can cost thousands) there are still many things that can be done to alleviate the problem. The usual trouble is overload of one or more RF stages or may be the mixer stage causing the pager to be superimposed on the wanted signal. Perhaps the signals get to the FM detector but then mix together, sometimes the pager can take over the detector completely. Remember, the pager can be a good fraction of a volt at antenna terminals, and the satellite will only be a few microvolts at best so with all that gain in the receiver you can see how over load can happen very easily. If your using a head amp with anything less than 100 foot of coax remove it immediately! You may lose a little range but the chances of loosing vital picture lines will be considerably reduced (and the pager always comes on just as you are getting to the best bit!!). Ideally use a switchable head amp so you can switch it in at the start and finish of the pass when it will be of use and switch it out when the signal is stronger. A well designed head amp can be switched out "live" without any effect showing on the picture if the signal is strong enough and a little experience will tell you at what point in a pass this is. Most decent switchable 2 Metre amateur bands head amps can be retuned to 137-138MHz, but take advice before shelling out! If you still have pager overload try reducing RF stage gain or fit an attenuator in the antenna lead. Basically, try to use the minimum signal level you need to get a decent picture; you only need enough to get over the FM demodulator threshold, anymore will not produce any worth while picture improvement and you may prevent the loss of vital picture lines. Also check the biasing on the RF stages as sometimes a vast improvement can be obtained with just a couple of resistor changes.

If the interference seems to come and go irregularly it may be produced by two signals getting into the mixer and beating together. If they are 10.7 MHz apart they will generate a mixer product at 10.7 and as this is almost certainly the IF of your receiver, it will enter the IF chain, and then you can do nothing about it. The effect will be present only when both interfering transmitters are on, should one go off then the interference will go as well. This is characterised by, say, garbled short parts of a taxi service coming and going intermittently, and this effect is independent of whether a satellite is in range. The cure here is to provide more pre mixer filtering more about this latter.

The local oscillator for 137.5 MHz will most likely be on a 126.8MHz and any signal on 116.1 MHz will beat with the 126.8 MHz LO to give a signal on 10.7 MHz which will be duly processed by the rest of the receiver. This is known as "second channel interference" and any receiver worthy of the name should have sufficient pre mixer selectivity to prevent this being a problem for most reasonable signal strengths. However, you may be unlucky enough to have a near by transmitter on this frequency and be in trouble, but only on the one satellite channel. Assuming the LO is below the receive frequency as is normally the case, a rule of thumb is that if you have a strong signal twice the IF (21.4MHz) below your receive frequency you could have a problem. Again this problem can be cured with better pre amp mixer selectivity which will also eliminate any chance of other LO harmonics causing trouble.

If your receiver has inadequate IF selectivity you may be in trouble only when receiving satellites at the top end of the band. If you are receiving Meteor on 137.85 and there is a pager on 138.005 there is a good chance that the pager signal will slip through and get into the demodulator. It's a characteristic of FM detectors that the strongest signal "captures" it and effectively takes over the receiver; this effect is exploited by the broadcasters to pack more stations into their allocations. The proper cure for this is to improve IF selectivity but this may be very difficult to do within the constraints of the receiver design. Most "budget" receivers use ceramic filters and they tend to give only limited results, but then a ceramic filter costs about a pound and you won't get much change out of 100 pounds for a good quality crystal filter. Again the alternative cure is to provide extra pre mixer selectivity.

One of the best cures for all these problems is to improve the antenna system. Crossed yagis are perfectly satisfactory in many circumstances, but have little gain or directivity. A multi element yagi antenna preferably of the "XY" type set up for right hand circular polarisation will have 7 to 12 dB gain and will be considerably directional. This can effect a cure except when the interference and satellite are in line. The only draw back is that it will have to track the satellite. This is fine if you record pictures for later viewing and can concentrate on antenna pointing, but this may not be possible especially if you like fiddling with framestores as the picture comes in, and of course precludes unattended operation. The ultimate is to computerise the satellite tracking and this will let you get on with more interesting things. A useful result of the extra gain is that you may not need the pre amp any more.

If you can't modify the receiver itself and have to stick with your existing antenna, you will probably have to add pre mixer selectivity to the receiver. Various designs exist for fairly narrow band filters which can solve the problem of second channel interference and remove the local taxi service without removing the satellite signal, but they cannot deal with pagers only a few KHz out side the band. If you're really stuck, a virtually guaranteed solution is to instal! a resonant cavity. They are widely used in repeaters where co sited tx and rx antennas are in use simultaneously, or sometimes the same antenna is used for both functions. The cavity prevents the transmitter output getting into the receiver, otherwise it would hear nothing ! (de-sensed). A resonant cavity is just a high "Q" tuned circuit made from a closed copper tube a few inches in diameter and about a quarter wave long. The signal is coupled through links on opposite sides of the tube at one end and the device is tuned by a rod running through the tube. The bandwidth will be narrow enough to reduce out of band interference, so narrow in fact that it will have to be retuned for every satellite, but the tuning knob can be calibrated accordingly. This should clear out of band interference, but this still leaves in-band problems.

My 2400 Hz source is generated from a 2.4576 MHz crystal divided by 1024. Unfortunately, the 56th harmonic comes out at 137.6256 MHz, and the first time I used this set up for NOAA 11 I got a screen full of herringbone patterns ! The cure was to put the generator in a tin box and filter power and output leads. This is an example of how easy it is to generate in-band interference. Framestores and certain makes of computer, eg BBC computer, can produce horrendous amounts of interference, although this is obvious the minute you switch then on. It can be an art in itself suppressing some of these digital devices. Sometimes low level interference only becomes apparent on close examination of the received picture, and tracing it can be a real pain.

Even some apparently normal tungsten and fluorescent lamps can produce VHF interference so you can have quite a search as anyone who remembers the old band 1 405 line TV transmissions will testify. Unfortunately, the faulty light fitting was next door !
Sometimes an unsuspected fault in the receiver itself can produce spurious signals on the output. Remove the antenna and replace it with a 47 ohm resistor and if the problem persists, start fault finding.

Transmitters are not perfect either, and can go faulty in addition to not having been set up properly in the first place, and it is entirely possible that an apparently good transmitter is radiating a "sproggy" especially if it is a modern synthesised rig, so if you're SURE your system is not at fault get in touch with the DTI and ask them to investigate. Perhaps it would be as well to ask a knowledgeable friend to check your finding first though !

Finally, it should be possible to look at the receivers specification to determine how good it is and how well it will stand up to in practice. Unfortunately, very few manufacturers specify the relevant parameters. For example, most receivers are specified as having a 6 dB bandwidth of around 50 KHz which is fine for NOAA , etc, but we also need to know the 60 dB bandwidth, and this is rarely quoted. Perhaps an enquiry will produce this information, but unless you know what it is you can't tell if the receiver will be any use. Ideally the 60 dB bandwidth should be about 100 KHz or less but if it turns out to be considerably more than this then it will probably be unable to cope especially at the top end of the band as I've shown. If you are going to spend three figure sum on a receiver you should find out its "third order intercept point" as this will be a measure of how well it will cope in the presence of strong signals. Parameters such as stability and sensitivity are nowadays generally perfectly adequate even in the cheapest receivers marketed for weather satellite use. A noise figure much better than 1.5 dB (about 140 degrees K) is pointless as sky noise at 137 MHz is at least 4 or 5 dB (500 degrees K minimum) so the design effort would be better going into strong signal handling.

If there is any interest in cavities to remove pagers I may be able to make some available, the cost would depend on the quantity required.

WANTED

Built and tested framestore, preferably boxed, no spaghetti please!;

Contact Mr. J. P. Beardmore
13 St Philips Close
Kettering
Northants
Tel 0536 515874

NEWS FROM EUMETSTAT

During October and November 1989 some problems with Meteosat-4 imagery were discovered. Sections of lines with erroneous grey levels (so called fishes) appeared on all spectral channels of METEOSAT images. The number of lines affected increased very rapidly until the image rectification became impossible.

Investigation were carried out during the METEOSAT-4 radiometer decontamination which was performed from 7 to 9 November 1989.
As a result, it was decided to switch the "synchronisation and Imaging channel (SIC) on board the space craft to the redundant unit (SIC2). The anomaly disappeared with the change over to the redundant unit. However, permanent monitoring of METEOSAT-4 imaging has shown a few isolated "fishes" during the use of SIC2.

Additional tests were performed during the decontamination exercise carried out at the beginning of December 1989 indicated that the problems with SIC 1 had increased dramatically although the unit was not in operation.
The problem has been under urgent investigation by ESA and industry but no firm conclusions have yet been reached. Further testing of METEOSAT-4 spacecraft will be required. The spacecraft has to be taken out of nominal operations during these tests. Extensive breaks in image dissemination were to be expected.

It has therefore been decided to move METEOSAT-3 from its temporary position at 50 degrees west where it was being prepared for "Atlantic Data Coverage" operations back to the nominal METEOSAT position to take over all METEOSAT operations during the test period.
The repositioning manoeuvre was performed on the 21st December 1989 and METEOSAT-3 is drifting at a rate of 1.6 degrees per day towards the nominal position. The spacecraft will be stopped at 1 degree East on January 1990.

After some spacecraft manoeuvres including a decontamination exercise operations will be transferred to METEOSAT-3 on
24th January 0900 UT.

The last METEOSAT-4 image will be scanned between 0730 and 0800 UT on 24/01/90.
At the time of change over between the spacecraft METEOSAT will be at a position of 1 degree west.

Users shall note that the beam width of typical METEOSAT User station antenna is:

6.8	degrees	=	1.2 m
6	degrees	=	1.8 m
3.7	degrees	=	3 m
2.3	degrees	=	4.5 m

Antenna with diameter up to 4.5 m, pointed to 0 degrees, will have both spacecraft in their reception beam and real time antenna pointing will not be necessary.

METEOSAT-4 will be moved towards 10.5 degrees west on 25th January and it is expected that it will reach this position on 13th February 1900.

The present dissemination schedule S8906M01 will stay in operation. This implies that the major WEFAX transmissions will be on channel A1 = 1691 MHz, digital transmissions and GOES relay transmissions from CMS Lannion will remain on channel A2 = 1694.5 MHz. Due to the alternating scanning of water vapour and visible 2 images during day time (even slots WV, odd slots VIS2) it will be necessary to replace some WV formats by those from previous image slots (ie WV formats from slot 33 would be replaced by those from slot 32). For the same reason AV and BIV formats of even slots will contain only VIS 1 data.

The layout of all disseminated data will remain identical with the exception of the satellite indicator which will be M3 and M4 correspondingly.
It has to be expected that some hours will be required to evaluate correct calibration values after the start of METEOSAT-3 imaging.
The validity of calibration values will be indicated by the corresponding flags in the interpretation data block in digital high resolution imaging transmissions.
Please note that METEOSAT-3 is still affected by problems of the "Electronic Dispun Antenna" (EDA) which cause periodic drops of 3 db in the radiated power. Nevertheless, all equipment designed in accordance with METEOSAT specifications will able to receive data in good quality.

At the present time it is not known when METEOSAT-4 will resume the role of the nominal spacecraft. You will be informed well in advance.

Robert Wolf, MOP Mission Manager

MEMBERS LETTERS

Dear Phil,

Last month a very interesting article on antennas was published in Electron. PA0KT (the designer of the famous faseloop ssb) made a what he calls a "one plane dish". Jan has put a lot of work in this Meteosat project and claims a 28 dB gain.

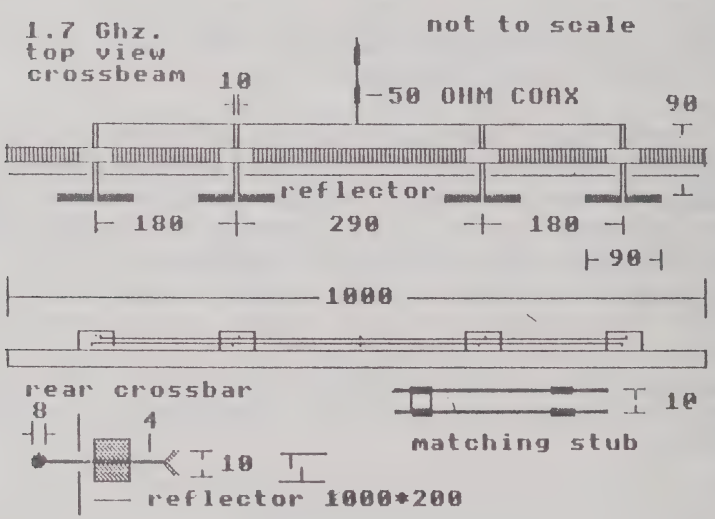
The basic idea is a sheet of perforated metal shaped in the form of a parabolic curve (instead of making a corner reflector or a trough !). The feed is "an array" of 4 dipoles. Jan has tried 20 different ways of illuminating this "semi-dish". Various numbers of dipoles were used but ended all up in having difficulties with the phasing. So in the end he decided to use 4 dipoles (90 mm).

From the pictures and drawings one gets an idea of how to construct this antenna. If necessary I will translate Jan's article in full but I have a feeling that everybody has his own ideas about the construction. All kind of materials can be used. No metal for the crossbar! The dipoles are made of 8mm brass/copper, 4mm brass for the rest. The reflector should have holes to let the half-wave lines for the dipoles through. Pieces of teflon are used to insulate the dipoles from the crossbar. The reflector should be positioned 1/4 lambda behind the dipoles and could be made adjustable. Instead of using sheet metal mesh can be used as long as the "holes" are smaller than 1/10 of the wavelength.

I have been thinking a lot about an antenna for the HRPT signals of the NOAA's. I prefer an antenna with a greater beamwidth than the dish (size 130 cm diameter). Helicals seemed to me a solution but after having done "me sums" I know that I will probably need at least 4 helicals and a lot of matching has to be done to get the necessary gain ! Writing this I remembered having seen pictures of dishes being used on 4GHz with helical as feed. Looking up this article in UKW-Berichten (4/1987) I found I had forgotten the special reflector having been added to get the right illumination (diameter of reflector 0.7 and 0.2 lambda for the edge). With not too large a dish it could be the solution for the right beamwidth. See drawing based on "a" design in the VHF/UHF hand book of the RSGB. Don't forget the dish is also a mirror as far as polarisation is concerned.

Another worry is how to track the satellite. I am using two programs on by BBC. Satfoot and an American program, which seems to be very popular over here. I was very satisfied with both programs until I started to compare elevation and azimuth of both programs. Especially with "overhead" crossings differences of 20 degrees (elevation) are no exception ! And what about Kepler elements ? I compared (Satfoot) Kepler elements from two different sources with an interval of 20 days. This did not make me feel very happy either.

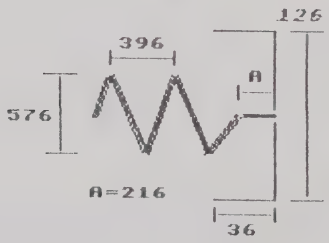
So we keep thinking
73's Jan Jaeger.
PA0TBE



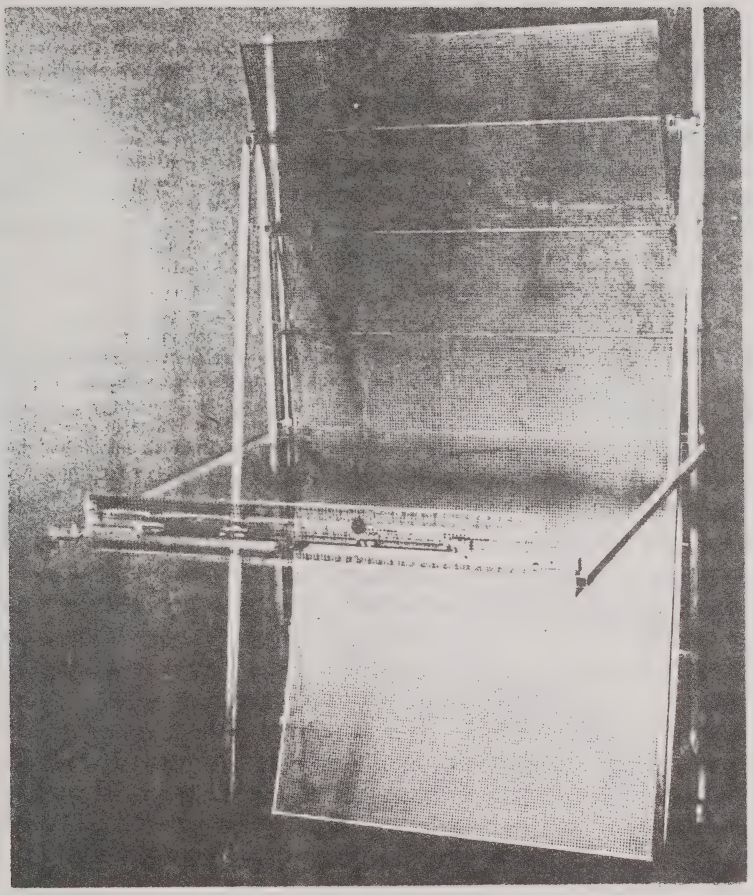
dipole

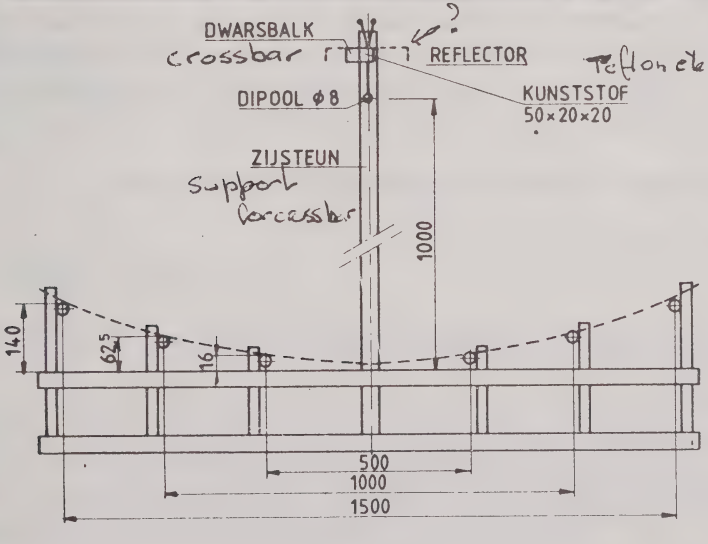
measurements in mm's

TBE



circular feed for 1.7




DWARSBALK
crossbar
REFLECTOR
Teflon ck
DIPOOL ϕ 8
KUNSTSTOF
50×20×20
ZIJSTEUN
Support
forcrossbar
1000
14.0
6.25
16
500
1000
1500

Dear Phil,

COLOUR MODULE
I built the synthetic colour module as described in the original framestore article and had very poor results. Now that I work in the applications lab of Philips components I can dabble in areas that I couldn't before. My idea is to take the latched 6-bit data from the memory and route it via a PROM to a TEA2000.

The TEA2000 is a 6-bit colour modulator for teletext applications. Feed it sync and blanking signals as well and it produces PAL or NTSC video. The PROM allows for selectable colour tables to be used depending on the picture content. The only question to be answered is whether I can get the information out of the PROM fast enough (it looks like I can!). The general consensus is to try it and see. I would like your assistance on two points. The first is that I would like to get in touch with someone, preferably on the committee, who would be willing to take a prototype and demonstrate it to the committee i.e. they need to be interested in such a project and have a TV or monitor that will take a 1 volt PAL signal.

The second point is that, assuming it all works, I will produce artwork and circuits and give the whole thing to the RIG group. I would also write an article that could be submitted to VHF COMMS for publication. The only recognition that I would ask for is acknowledgement as the author of the article. The RIG group can reap any benefits from the interest the module generates. I have obtained a lot of information from RIG by being a member and feel it is time that I reversed the information flow. RIG group exposure at a technical level (in Europe) can only help the group.

I look forward to hearing your comments on these topics.

Graham Moss ZL1TTX.

(Eds note: I will be contacting Graham and taking up his offer for the group)

Dear Phil

Thanks for the mention in RIG regarding my satellite AOS Prediction program. I have had one or two enquiries for copies, and subsequently favourable comments. If you care to publish my address, I will be happy to supply a copy to any member prepared to forward me a blank disc, packaging and return postage.

As is the way of things, the program has evolved since I last wrote. No longer is there the tedious drudgery of typing new Kepler data directly into the program itself.
Keplers are now held in a separate data file, and read automatically into the " Predict " program when it is run. Additionally, an editor program is included with the package, making the updating of Keplers from the RIG printout child's play
(I hope).

I can provide the program on virtually any BBC Micro format (Master DFS or ADFS, and Archimedes). On the latter machine, it runs ten times faster than on the master.

A couple of months ago I realised an ambition of some standing when I purchased an Archimedes micro computer, and fitted it with the Spacetech Framestore Podule. Results are really fantastic - virtually Photographic image quality on the screen. When I have time I will be photographing some screen images to see how they turn out.

Yours sincerely
Les Hamilton
8, Deeside Place
Aberdeen AB1 7PW
Scotland

4X - ZOOM (another solution)

The 4X zoom mod offered in RIG 5 suffers from a few disadvantages.

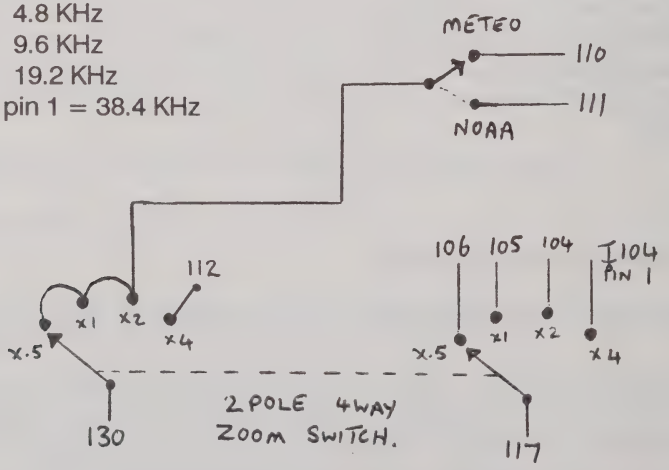
1. Grounding pin 6 on I219 has the effect of only accessing every other line of memory, those other lines will lose their memory after a short while since there is, in effect, no refresh taking place. As a 4X picture is being loaded in one "page", full size images in the other three pages will be slowly corrupted on alternate lines.

2. This grounding of pin 6 has the effect of showing each line of image as two lines on the monitor, this produces chunky pixels which I was disappointed with.
3. Although the image is four times larger, their is only an increase of two in the amount of information shown, half the memory capacity is being wasted!.
I wanted to use all the available memory for the 4X pictures and it appeared possible by altering the height to width ratio, i.e. by increasing the horizontal resolution by 4, but only increasing the vertical resolution by 2 (no vertical detail is lost, each line transmitted is still used.)
Although this alters the perspective somewhat, I found that the images were more like one sees in maps, and perfectly acceptable.
One benefit of all this is that a NOAA 4X image of Great Britain now fills the monitor perfectly.
The solution was surprisingly simple, and cost nothing !
The line clock (point 130) is now obtained from the point 112 via a second pole on the zoom switch. All the other connections are as RIG 5 except the connection to I219 pin 6 is not required.
I decided to use a four position "zoom" switch, with a separate "NOAA/METEOR " spst switch (which is ignored in the 4X zoom position).

R J Valder G4XCA.

x4 Zoom - Circuit details:

106 = 4.8 KHz
105 = 9.6 KHz
104 = 19.2 KHz
IC104 pin 1 = 38.4 KHz



Do not use connection to IC 219 pin 6 (not needed now).

Dear Phil,
Just a line to let you know that I an receiving Meteosat now. The Dartcom converter works very well and I must congratulate Henry on his Yagi design, I made this up using 1/8" brass rod for the loop elements and with 40 directors it seems to give reasonable picture. When listening to the sound of the signal there is some noise but it is not easily seen on the picture and that is where it matters.

I was very keen to load up a sequence of D2 infrared pictures and make use of the "film mode" of the framestore, but when the picture was loaded and one stepped the sequence round it is obvious that the end of the picture is in the middle of the memory. What is needed is a means of resetting the memory so that after the reset the rest of the picture exactly fills the screen. Some experimentation revealed that one has to reset at approximately 80 seconds after the start of the picture. With the D2 picture this point occurs just when the "+ + +" representing latitude 30 degrees north come into view, these are the SECOND row of "+"s and one should press the reset button 3 screen lines beyond the horizontal bar of the "+". Doing this every time will give a series of pictures in the memory with the coastlines in the same place every time.

If, instead of pressing the reset button you halt the display at this point, you can fix a little marker to the monitor screen to indicate the position of the start of the picture when the reset has to be pressed. In this way you can make sure that the pictures other than D2 can be loaded in this way.
It is fortunate that the UK is in the upper half of the image as the lower 30 % or so is bound to be discarded.
I hope that other readers find this idea useful

With all the best wishes for 1990.....the start of the last decade of the second millennium!!!!!!

Grant Dixon

Dear Phil,

High Resolution Satellite pictures

With the introduction of the EVGA graphics cards over the last 12 months for the IBM PC, it is now possible to display satellite pictures of a quality only previously available to dedicated hardware designs. Such graphics cards are capable of a resolution of 800 pixels by 600 lines by 64 shades of grey or 256 colours. Several companies have started to make use of the graphics quality offered by such hasrdware. To date I have found four such software based systems from England, Holland and two from America. Probably the best I hasv seen so far is an English product caled MET-2 from ICS Electronics. It was only yesterday that I went down to ICS to look at this product in detail. In view of the imminent closing date for articles for RIG 20 I have decided to take stock of the product in detail rather than rush something together, and will produce a report on this product for the June edition. Hopefully I will be able to review the other products in the Sept. edition. If anyone wants any info. in the meantime perhaps they could send me a return stamped addressed envelope and I will forward the details that I have.

Peter Dobson
Hartside, Back Lane, Bucks Farm Oak, Farnham, Surrey, GU10 4LW

Secretaries Report (Contd.)

David Bailey regularly receives the NOAA APT information notes and he advises that the launch of NOAA-D is scheduled for late June. If it reaches a successful orbit it will become NOAA-12. This is an old NOAA spacecraft, a spare brought out of mothballs, and therefore does not have the Search & Rescue and other facilities of the later spacecraft.

The more observant of you will recognise that this months Keplers are attributed to Max White of The Kettering Group, not the Royal Greenwich Observatory. The RGO operation at Herstmonceaux closes down this month and most of the highly qualified staff including Max White are leaving to do new things.
Government cutbacks strike again.

See you in June, Phil.

AMIGA CORNER
James Brown

Do you want the good news or the bad, first? O.K. let's get the bad out of the way. It looks as if ICS are unlikely to be able to do a 1.3 version of their own fax unit. The German programmer has now moved on to higher things and doesn't seem to be interested in re-writing the software for a few more Deutschmarks. Further bad news is that it may not simply be a case of swapping the Kickstart ROMS, other PAL chips may be involved, so before you go our and spend what remains of your money after the Building Society has taken its cut, please bear this in mind. Mind you, older 1.2 AMIGAS are a terrific bargain at the moment if you can get hold of one.

However the good news is that there are several alternatives. ICS itself is field-testing an American AVT-Video system, which they're hoping to put on general release shortly, and that will be a hardware/software package, retailing around the £299 + VAT figure. As with other firms they are also marketing their own receiver the MET-2, and this comes with a different s/ware package, which bears a striking resemblance to the package offered by Timestep! Even the cost is the same at £599 + VAT. Hope chips don't go up too much in the near future, otherwise it might cost £600 which is an awful lot more!!

Which brings me to a mini-review. No not the car, but one of our RIGleys (as my wife endearingly insists on calling us!) Bob Howitt from Orpington, has recently taken delivery of the Timestep Amiga package, and with his permission the following description and comments seem relevant:

'Very pleased with the system... Easy to set up... worked first time. Several display resolutions, up to 600 X 400 in 16 grey levels. Unattended operation for feeding in the regular half-hour METEOSAT transmissions...would have liked the option to vary the time interval. Animation is excellent, with 11 low resolution pictures (with the standard 1/2 meg upgrade) constantly cycled with a flicker-free display. Manual is fair. Commodore Monitor blew up last week! Got the NOAA & METEOSAT receiver hardware from Satellite Systems in Wickford (Tel: 0268 764479)'

Thanks for the comments Bob, and to all who keep in touch. The phone rings about two or three times each week and I often get asked if the disk offer is still on, to which the reply is a yes, but please telephone first, so that I can remind you of the options, and the best method of ensuring a swift reply.

Lastly, it looks as if our chances of receiving GOES East direct, are going to undergo a severe set-back from the beginning of March. GOES5, the re-transmission satellite has finally run out of fuel to keep it on station, so it will be drifting at .25 of a degree a day to the West, so bye-bye GOES. Or should that be 'satellite GOES West!' Last orders are now being taken for NOAA mosaics and GMS relays! With no contingency plans, and the next Geostationary launch not due until late next year at the earliest, the NOAA GOES programme is going to be in considerable disarray for the forseeable future. My hurricane ictures from last summer should be like gold!! Rumours of the loan of MET3 have probably been finally put to rest by its re-introduction by EUMETSTAT, following difficulties with MET4. Anyone want a 'Henry' Yagi???
Only joking...

James Brown

RMO/RSGB Meeting report by Ken Willis G8VR

On the 28th October, a most interesting meeting was held at Imperial College, London, sponsored jointly by the Royal Meteorological Society and the RSGB. This event was the brain child of Jim Bacon, G3YLA, better known as Anglia TV's "weatherman". Eight specialist speakers spoke on a wide variety of topics to an audience of about 150, meteorologists and radio amateurs. In the chair, Professor Steve Thorpe of Southampton University, who, as an oceanographer declared himself to be quite impartial, emphasised that this was intended to be a discussion meeting dealing with the impact of radio on weather measurements and related data communications. He introduced David Evans, G4OUF representing RSGB, who thanked the Meteorological Society for their co-operation in the smooth organisation of the event which would hope fully be the forerunner of many others.

The first speaker, Martin Stubbs of the central Meteorological Office, Bracknell, admitted to an interest in radio since school days, his main current interest being the reception of operational transmissions providing weather data. In an overview of what is available, he listed voice broadcasts, Morse transmissions, radio facsimile, the Navtex service, domestic television, meteorological satellites, radio and radio teleprinter routines. Specifically he mentioned weather information available from civil aviation broadcasts on VHF and HF, mainly directed towards aircraft in flight, and the RAF Volmet service transmited on 4.722 MHz and 11200 MHz sideband.

Among many Morse transmissions, to numerous to detail, he recommended Portishead Radio which regularly transmits coded weather analysis data, mainly for shipping, While Navtex is a dedicated system for ships transmitting on 581 KHz to those vessels fitted with appropriate reception equipment. Martin commented that today, domestic television provided very good weather information with animated maps, while a very useful program for farmers, provided by Bracknell, was transmitted every Sunday at 12:55 pm.

Many teleprinter signals are available "off the air" for those with specialised equipment, and in this context, the application of micro computers for rtty reception had greatly simplified matters compared with his own early days using Creed machines. Finally Martin commented that although a licence costing ten pounds is strictly required to receive weather satellite data from some or all the sources he mentioned, if the data collected is solely for the personal use of the operator, this requirement was unnecessary.
Martin Stubbs said that he could provide a focal point for requests for more detailed information on what was available. Possibly it would be best if any such request are coordinated by RIG and information of general interest to RIG members is printed in a future news letter.

Dr Richard Pettifer then gave an account of radiosonde equipment. Having joined the Meteorological Office from school, he left in 1985 to become managing director of Vaisala UK Ltd. which now manufactures some 250,000 radiosondes each year. The basic requirement for a radiosonde is for a lightweight, cheap, disposable unit capable of measuring temperature, humidity and pressure at altitude, which allows, among other things, for a calculation of radio refractive index. Such units were in use before 1939. In operation, several units are launched simultaneously from widely separate sites and the data co-ordinated.

The three parameters measured are conveyed to ground stations by an audio tone telemetry system, multiplexing between channels being achieved by the use of a simple wind driven rotary switch mechanism. Amplitude modulation in the 27 MHz band, use extensively in the past will eventually be superseded by modern units designed to operate at 403 MHz with frequency modulation. Dr. Pettifer showed a 403 MHz unit entirely built on a single PCB, including logic circuits and a built in receiver to receive standard navigational aid signals which permit the device to derive its own positional information and deduce wind data, something which is lacking in the older models.

Some idea of the problems facing radiosonde design engineers can be judged from the fact that as well as being lightweight, cheap and disposable, radiosondes must be capable of achieving high measurements accuracy in temperatures varying from -80 to +30 degrees Celsius.

The required operational range is 200km, and a typical mission lifetime is 2 hours. Accuracy figures for latest models are temperature: 0.1 degrees Celsius on the ground, 0.3 degeees Celsius at altitude and 0.5 degrees Celsius at the top of the flight path: humidity measurements within +/- 5%.

The next speaker, Henry Neale, requires no introduction to the RIG members present nor to many of the radio amateurs in the audience. Henry described the process of automatic picture transmissions and their reception by amateurs, stressing the relative simplicity of the equipment required. He was ably assisted by Peter Newman who displayed some beautiful video pictures to illustrate Henry's text. These and some animated pictures from Meteosat left this reporter in no doubt how far his own equipment must be improved to match the resolution and grey levels apparent in the image shown to the audience !

Dr. Tony Lee described a VLF thunderstorm location system developed by the Meteorological Office based on early cathode ray direction finding work by Watson Watt. Receivers tuned to 10 KHz are set up at widely separate sites where the impulse generated by a lightning strike can be received and recorded. The time difference recorded between different sites enables a calculation to be made of the distance of a strike from any particular station, enabling the location of the strike to be calculated.

As might be expected, analysis of the data is not that simple, and can be further complicated by the fact that the D layer reflections at 10 KHz can sometimes result in the arrival of more that one signal, one direct and the other via the ionosphere. However, by 1987 with 7 UK stations operational, the system had been refined sufficiently to give a positional accuracy of 3 Km. For the future, the establishment of stations outside the British Isles will give longer triangulation distances, and the greater accuracy should be possible. Currently, results are analysed by computer virtually simultaneously with the arrival of a signal.

The afternoon session opened with a description of the radar installation at the Chilbolton Observatory of the Rutherford Appleton Laboratory. I was particularly interested in this since last summer while driving through the west country I happened upon this site and was impressed by the 25 metre dish pointing skywards, and wondering what its function might be.

John Goddard, a scientist at Chilbolton, said that the radar has several uses related to microwave propagation, but on this occasion he dealt with its application to meteorology, specifically studies into rain intensity and distribution, cloud physics, hail direction and lighting prediction.

The radar has a beamwidth of 0.25 degrees, which put another way, means that the width of the beam is only 130 metres at a distance of 30 Km from the transmitter. The erp of the radar is 60 KW with a prf of 610 Hz separation between pulses is 1.6 microseconds. Typically for rain and associated studies the radar transmits horizontally and vertically polarised pulses alternatively, which provides information on the shape of the droplets (typically 1mm to 6mm diameter). These become oval as their size increases. John said the radar signal suffers very low attenuation through cloud, but the back scatter from rain droplets gives a high signal noise ratio and good discrimination. Excellent prints were demonstrated in which different colour values had been assigned to different signals return levels showing clearly the ice and droplet formation within a rain cloud.

The three remaining speakers were all well known radio amateurs whose topics have been the subject of articles in the Radio Communication or the RSGB VHF Handbook, or both. Jim Bacon G3YLA gave an account of sporadic E propagation (see Radcom May June and July August 1989).

The interesting theory of wind reversals (shear winds) in the upper atmosphere which have the effect of compressing ion layers into thin films, increasing ionisation levels to the point where VHF signals are reflected was described. The effect of Meteor input and the semi-diurnal "tide" on sporadic E propagation were also dealt with in a talk which Jim was forced to condense information normally contained in a lecture lasting about 2 hours into a mere 20 minutes, a feat which he accomplished with the professional presentation for which he is noted when seen by a much wider television audience.

Ray Flavell, G3LTP a long time member of the Meteorological Office until recent retirement enlightened some of his erstwhile colleagues on the effects of radio refractive index on VHF/UHF propagation. Ray made the point that some professionals still find it difficult to accept that amateurs cover ranges that we now take for granted on our VHF bands, and commented that standard references still cite almost "optical" ranges as the maximum achievable at VHF.

To round off a most enjoyable day, Charlie Newton G2FKZ, the IARU auroral coordinator and grand old man of the auroras gave an overall account of solar conditions which give rise to auroras, using solar Cycle 21 as his model. Most radio amateurs will have heard of or read about Charlie's theories which are now generally accepted. Meteorologists present may have been confused between visual and radio auroras, but they were left in no doubt as to the enthusiasm shown by amateurs for such events which help them to extend their range to parts which other modes cannot easily reach. Perhaps we shall see some Meteorologists getting interested in amateur radio as a result of the meeting; possibly some radio amateur will take a more serious interest in the weather. One thing is certain, the meeting was a huge success. Jim Bacon is to be congratulated for conceiving it, and we hope there will be many more on similar topics in the future.

IMAGING STATION ACCESSORIES
by John Morris, G3PHA

Having been a Muirhead Facsimile machines of long standing indeed since the early 1960's, a few years ago decided to move with the times and successfully completed the YU frame store incorporating along the way the well known minor modifications. I have been pleased with its performance considering its limitations.

Encouraged by the burst of construction activity and to further practice soldering skills I was looking around for other projects to under take which would also assist the operation of my imaging systems when I came across a copy of the winter 1988/89 Cirkit catalogue. Two kits I thought could be of use, one was a radio code clock, the other a video monitor test card generator.

Radio code clock (stock No 41-00506)

Referred to as the Rewbichron 2 model it is a microprocessor controlled and based on the well known 60 KHz V L F radio transmissions from Rugby. The kit when completed though requires a small but simple 60 KHz receiver to input the digital data to the microprocessor board. If required a suitable receiver kit (stock No 40-06002 0) is also available.

The clock kit also comprises of two pcb's and all the various IC's and components but excluding a cabinet or box. The main logic/microprocessor board is 145mm x 100mm and the display board, accommodating the eight digit, 12mm, displays, is 105mm x 55mm.

These two boards were very soon completed. The display board however I considered to be too small for the number of components used and the pcb tracks, in places, very close together and the board design unlike the microprocessor board not allowing adequate space for the fixing holes.

I assembled this board using it only for test purposes in order to verify that the main logic board and 60 KHz receiver were in working order. I redesigned the display board and used the larger 25mm high led's. The whole kit is incorporated into a 19 inch wide rack unit with engraved panel.

The clock displays hours, minutes and seconds and switch selectable date. All useful for checking prediction data. Like the frame store it was satisfying to get working. No doubt the digital data to the display could be "fanned out" to operate the other equipment automatically.

Test Card Generator (stock No 41-00705)

This kit could be useful in providing a signal source for checking the frame store video monitor should it ever fault. Also between satellite passes, instead of looking at noise patterns, a test card display would be more pleasing to the eye. This kit is also referred to as the Cropredy test card generator is based on an eprom which can be programmed not only to provide a test card pattern but also to include personal details such as, radio call sign, name, address etc with limitations. The eprom is supplied from a separate source and attracts a small additional charge.

The kit of parts, like the radio code clock, is well presented and its pcb of good quality. During construction no undue difficulty was experienced provided care is taken over soldering and the usual checks made before applying power.

A suitable box or enclosure will have to be provided.
A current Cirkit catalogue with up to date prices can be obtained from newsagents or by post direct from:-

Cirkit
Park Lane
Broxbourne
Herts EN10 7NQ
0992 444111

The eprom can be obtained from the Worthing video repeater group who will program the device from a selection of up to 11 different patterns. The group also provide various add ons which will extend the generator facilities to include colour and accommodation for up to 8 eproms and hence a similar number of test patterns.

Your own personalised test card can be based on:

(1) IBA monochrome style test card with your own call sign in large characters and two lines of smaller text.
(2) An IBA colour test card
(3) An EBU test card
(4(Grey scales
(5) Crosshatch
(6) Frequency gratings

For further information and order form with SAE write to :-

Worthing Video Repeater Group
Toftwood
Mill lane
High Salvington
Worhting BN13 3DF

HOLIDAY WITH A DIFFERENCE

John Morris

My attention has been drawn to a unique holiday, details of which are still being worked out, ideal for RIG members.

A chance to really get away from it all and indulge in radio communications, facsimile, satellite imaging, meteorology etc.
Anyone interested in spending a few weeks holiday on board an ocean weather ship, on station in Mid Atlantic, departing from and returning to a UK port should contact Chris Gardener at

Shipping agents
Curnon Shipping Ltd
The Shipyard
Porthleven
Helston
Cornwall
TR13 9JA

or phone 0326 563434

WEATHER FAX GREY SCALE GENERATOR UPDATE

John Morris

Members will no doubt recall the article by George Isleib (W3CPR) which featured in RIG newsletter No 15 page 48.
The article describe an electronic unit which generated grey scales of either 8, 16, or 32 shades, at selectable line scan rates of either 120 or 240, and based on a 2.4 KHz carrier. A useful accessory for the setting up of the frame store/video monitor combination and for contrast adjustments to Muirhead fax machines.

Shortly after the issue of RIG 15 John Morris (G3PHA) was in touch with George who said that all his pcb's had been sold and at that time he had no plans to produce anymore. In fact George was concentrating on the development of an electronic "GOES" signal test card simulator.

However, John has recently received a letter from George who disclosed he has "for the time being" put off the simulator work due to its complexity but has redesigned the grey scale generator following a great deal of interest still shown in it. The revised generator is now available in kit form complete with 9 1/2" x 6" pcb, IC's, capacitors, transformers etc.

The purchaser will have to find a cabinet and a couple of switches.
The specification now includes 2.4 KHz outputs at both AM and FM at 1 volt PK-to-PK, grey scales of 8, 16, 32 and 64 shades, line scan rates of 60, 120 and 240 lines per minute. Cost $100

Further details and kit purchase contact:-

George T Isleib (W3CPR)
RD 1 BOX 272
LEIGHTON PA 18235
U.S.A.

MEMBERS ADS:

For Sale

UKW-6 Weather Satellite Receiver, 6 channels. Excellent condition £90.00 ono.

Microwave Modules 1690 MHz Satellite Converter (for Meteosat etc). Plugs into UKW-6 receiver. Unused £90.00 ono

2 RX400 Fax Machines, one working the other in slight need of attention. 4 boxes of paper and manuals £35.00 ono

ICOM-215 2 Metre transceiver. Xtals fitted to all 12 channels. £70.00 ono

Peter Fleet, G8SYT
33, Spital Terrace,
Gainsborough,
Lincs.
Tel 0427 616180.

For Sale

Several rolls of 'TELEDELTOS' paper (2.5" wide), I used the paper on my old homebrew fax 1965 - 1970, ESSA, NIMBUS etc

If anyone can use these, then arrange to collect and make a donation to RIG,

Ron, G3CAG Tel 0908 376707

For Sale:

DARTCOM downconverter, in environmental case.

£150

DARTCOM Scanning receiver with frequency display, s meter complete in a case.

£170

METEOSAT dish, feed horn, low loss cable, all assembled and mounted on a sturdy base, fully adjustable.

£70

SPACETECH Archimedes weather satellite control and display system. Still frame and animation packages. Complete with Podule, documentation and software.

£240

ACORN I/O Podule with MIDI upgrade

£82

Jaybeam Turnstile aerial, excellent for Polarorbiting satellites

£40

Jaybeam 8 element XY aerial for 137 MHz

£50

Special Offer:
All the above items, a complete satellite tracking and display system (NOT including the Archimedes computer) for only £750.

All items are in full working order as new with full documenetation and packaging. This system configuration is highly recommended (similar to that of my own).

Contact Peter Newman on 0487 812121

For Sale:

Tektronix 555 valved Double beam oscilloscope. Full working order. Two separate time bases and delay facility. Complete with power supply unit. Size of scope 2' x 18" x 1'
£50.00 buyer collects.

Large range of brand new LS and S type 74 series chips at the fraction of normal cost + 64K 200ns memory chips for only 50p.

Ring for details

James Brown
0656 712632

STOLEN EQUIPMENT

The equipment listed below was stolen from my shack in early January. If any equipment bearing the serial numbers below is offered for sale I would appreciate your help by contacting me (Tel. 061 962 4383) or the Trafford Police, Altringham area (Tel 061 872 5050):

Model	Serial No.
Trio TS830S	204080
Kenwood DFC230	1090004
ICOM IC2E	10373
ICOM IC202	4575
SOMMERKAMP FT290R	5G450430
WELZ SP350 Power/SWR meter	353704
ICOM CB1050 converted for 10m	

Doug Quale, G4NAV

D900 Plugs & Sockets

One of our member has advised us that plugs and sockets and accessories for the D900 series of FAX machines from Muirhead can be obtained from Unitel Ltd, Unitel House, Fishers Green Road, Stevenage, Herts, SG1 2PT. Tel No. 0438 312393 Direct Sales. Prices for these difficult to obtain plugs start from £6.00.

Help Needed

Muirhead K-401-D Fax machine
Would someone undertake the mechanical and electronic modifications to enable it to work on Meteosat, NOAA and Meteor for me?
Will deliver and collect - preferably SE England, good price paid.

John Tellick. 01 390 3315 (Surbiton, Surrey)

For Sale:

Maplin decoder with Maplin and Spacetech software for BBC 'B' or Master. Cased and in good order. £80 the lot ono. May split.
Gareth Evans 01 657 2944, evenings or weekends

RIG HELPLINES:

General Enquiries & PCB Supplies
Phil Seaford 0525 384419

NOAA info. Henry Neale 094 585 353

Russian, Chinese satellite info/status
Les Currington 0707 326058

Schools/ Educational enquiries,
Meteosat status and Colin Hall School 021 778 1311
European Space Agency Home 021 449 0006

Framestore technical support:
Mike Coombs 0530 243494
7.30pm - 9.30pm

Ian Gurton 05827 377
7.30pm - 9.30pm

Dermot Dobson 22 Ramsey Road,
Headington, Oxford.

RIG Dish & Feed Horn Stockists:
see back of previous newsletters

Supplier problems co-ordinator
Stan Ames 05827 60538

RIG at Rallies 1990
Mike Coombs see above for No.

RIG MICRO SPECIALISTS:

BBC Micro	Stan Ames	see above
Commodore Amiga	James Brown	0656 712632
Atari ST, Archimedes	Peter Newman	0487 812121
IBM PC	Dermot Dobson	see above

Please call at sensible hours ie 7.30pm - 9.30pm

Talk in 2 mts
4 mts
160 mts

Dunstable Downs Radio Club
Present the 7th
National Amateur Radio
CAR BOOT SALE

RSGB

FORMALLY HELD IN SEPTEMBER AT SHUTTLEWORTH

Sunday 20th May
10 am until 5 pm
Car parking £1 to charity
To Be Held at

A great day out for the whole family

Floral gardens, Amusements, Various Displays, Craft Museum, Music And much more

Bargains for everyone, or have your own stall.

Computers, TV, RTTY,Transmitters, Receivers, Microwave Aerials, Components, Satellite

Over 250 stalls last year.

Stockwood Park

Farley Hill entrance, Luton Nr M1 Jun 10

Run in conjuction
with
Rotary Club of Luton

Cost of plots

Private £7 in advance,
£9 on day
Trade £20 large plot

Send cheques made payable to
DDRC
c/o 125 Telscombe Way
Luton LU2 8QP

Please enclose S.A.E.
other enquiries to
Wendy 0582 451057

martelec

SYSTEMS & MODULES FOR BBC, ARCHIMEDES

ARCHIMEDES SYSTEM

Easily the best system currently available for the Arch. We offer the superb Spacetech Podule and software with the Martelec MSR30 receiver, MSC20 low-noise downconverter, and MSD20 95cm dish aerial. We believe this is an unbeatable package, combining the best of software and hardware.

The latest software release can be fully exploited with the MSR30 receiver, enabling full NOAA passes to be stored in high resolution.

This highly acclaimed system has many, many useful and clever features - too many to list here. To find out more, ask for our info. pack.

Spacetech Podule & Software	£299.00
MSR30 Receiver	£328.00
MSC20 Downconverter	£172.50
MSD20 95cm Dish Aerial & Feed	£156.00
MSA20 Cross-dipole Aerial	£39.95
Normal price	~~£995.45~~
Special offer price	**£895.00**
Carriage & insurance	£18.00

WXSAT BBC SYSTEM

The popular WXSAT System has now been upgraded with the new MSR30 Receiver. Although being the 'entry level' system, WXSAT software package has a surprising number of unique features, and produces a respectable 160 x 250 pixel resolution, with 8 greyscales. This remarkable system features zoom (up to x8) without loss of screen resolution, disc read/write printer dump routine, user defineable colour pallete, text overwriting, and a host of set-up and graphic features.

The system may be economically upgraded to a high-resolution system by substituting the MSG20 Graphstore for the MSS20 Interface.

MSS20 BBC Interface and software	£86.19
MSR30 Synthesised VHF Sat. Rec,	£328.00
MSA20 Crossed-dipole VHF Aerial	£39.95
Normal price	~~£454.14~~
Special offer price	**£399.00**
Carriage & insurance	£6.00

GRAPHSTORE BBC SYSTEM

The MSG20 Graphstore System combines a 2 page, high-resolution framestore and graphics processor with the powerful GRACE software package to deliver the best images you've ever seen using a BBC micro - 512 x 512 x 128 greyscales, or 256 x 256 x 128 greyscales in 8-frame animation mode.

Zoom ratios are selectable from 1-16 with smooth X-Y scrolling over the whole image. Also included are four powerful contrast enhancement algorithms, complete with spectral hystograms. Text overlaying is provided in a choice of sizes, printer dump routine is available.

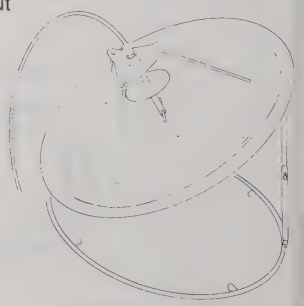
MSG20 Graphstore & software	£399.95
MSR30 Receiver	£328.00
MSC20 Downconverter	£172.50
MSD20 95cm Dish Aerial & Feed	£156.00
MSA20 Crossed-dipole Aerial	£39.95
Normal price	~~£1096.40~~
Special offer price	**£986.40**
Carriage & insurance	£18.00

MSD20 Dish Aerial

95cm Dish, mount, and feed assembly. A high-quality product using our latest silver-plated dipole feed. N-type connector output

£156.00

Carriage£18.00



WE SHIP DIRECT TO YOU ANYWHERE IN MAINLAND UK.

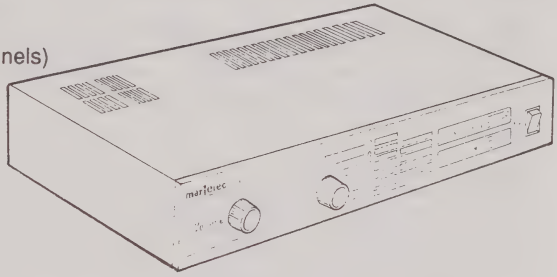
AMIGA, IBM..... *the widest range, of the best systems, at the keenest prices*

Introducing the new MSR30 SATELLITE RECEIVER.....

A meticulously designed and engineered second-generation satellite receiver for NOAA and Meteosat reception, setting new standards in performance – particularly interference rejection.

Features include:

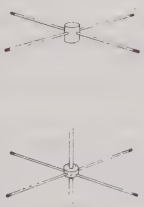
- Fully synthesized (6 preselected channels)
- Built-in scanner with intelligent halt
- High rejection of interference
- Auto tape record switch facility, with adjustable drop-out delay
- Separate built-in power supplies for receiver and downconverter
- Automatic Frequency Control
- Adjustable APT output level
- Tailored APT Passband filter



Complete cased receiver with all connectors and cables (except aerial) £328.00 incl.
Special offer price **£295.00 incl.**
Carriage and insurance £6.00

[Aerial cables factory-made to length: £8.50 plus 50p/metre]

MSA20 Crossed-dipole 137MHz Omni-directional Aerial.

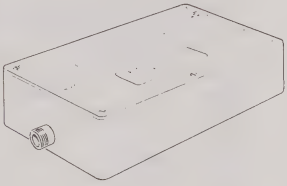


Supplied complete with phasing harness

£39.95
Carriage and insurance £6.00

MSC20 Low Noise Downconverter

With built-in GaAsFET preamplifier, this is the lowest noise downconverter in its class (typ. 1.0dB). Has temperature controlled crystals for Meteosat channels A1, A2 (1691MHz & 1694.5MHz). Output is 137.5MHz. Comes complete in weatherproof ABS enclosure, and with N-type to N-type cable and connectors. **£172.50**
Carriage and insurance £3.75



Book List

Weather Satellite Reception	Chris Hornby	£9.75+£0.60
Introduction to Satellite Television	F A Wilson	£5.95+£0.60
VHF-UHF Manual	RSGB	£8.94+£1.60
Satellite Experimenter's Handbook	ARRL	£6.47+£1.00

Send a SAE for full list of publications

ORDERING INFORMATION All prices include VAT. Payment by cheque or postal order made payable to 'Martelec Ltd'. Visa & Access cards accepted.
108 Queens Road, Farnborough, Hants, GU14 6JR. Tel. (44) 0252 376068 Fax. (44) 0252 737620

spacetech

L. E. Hornby, 21 West Wools, Portland, Dorset DT5 2EA. Tel: 0305 822753

Spacetech News: Those of you who are teachers might have seen us at the BETT show where we were presented with the Educational Technology Award 1989/90 by Alan Howarth, the Minister for Schools. The award is sponsored by the British Educational Equipment Association and the Educational Computing and Technology magazine and the Gold Award was won by our Weather Satellite Podule for the Archimedes. If you would like a detailed specification on this and/or any other of our range of space science resources please give us a call. Demo discs, interactive or animation are £5.00. (also for Atari)

NEW: RGB/Greyscale card. ALSO:SHF receiver with computer interface. VHF receiver with computer interface. The original SHF-Design Yagi from Germany available ex-stock, NOT a Chinese copy..superbly engineered and gives excellent results.

ALSO: ICS FAX1, Digitar weather equipment, HF225 etc etc phone for quote.

BOOKS:	Price
Sourcebook of Remote Sensing: D.J.Carter. A guide to products, utilities etc. V.useful information source for enthusiast.We are now the only source of this valuable book and stocks are limited	15.00
Guide to Facsimile Stations: Klingenfuss. A wealth of information not only on FAX but NOAA,Meteosat etc.News agencies, Meteorology.	12.00
Weather Satellite Reception: Chris Hornby. A guide to get you started, Aimed at the beginner,but useful reference.	4.95
Britain from Space:Colour Landsat Atlas of British Isles.	12.50
The Home Planet: Superb large "glossy".(needs a big coffee table) The ultimate in colour reproduction of earth images from space. Price includes £2.00 P&P premium:	24.50
Atlas of Deep Sky Splendours: Another super glossy to weigh down your coffee table at Christmas!	29.50
Amateur Astronomy: A comprehensive and practical survey. Large and contains hundreds of colour pictures.Very good value.	7.95

Posters and prints: We have a large range of posters, far to numerous to fit in this advert, ranging from Europe (NOAA HRPT colour) at £1.50 to the Earth by Night at £4.95. Prints range from 0.95 (5"x7" Earth from Apollo) to 19.50 (Large glossy prints from NRSC) The Earth from Apollo laser scan print (16" x 20") at 6.50 is worth seeing.
The Earth by night poster merits a special mention, it is a Mosaic of night time satellite images in visible light: Shows energy use and artificial light distribution: Comprehensive key and text leaflet. Superb conversation piece!As reviewed in the Guardian) Luminous! 4.95
new: Huge, square, textured and luminous + book - The Ocean Floor poster. Takes your breath away..only available for collection: 10.00

Videos: STOP PRESS: All NRSC videos only 9.95 TO BUY!!
Introduction to Satellite Remote sensing.Towards a greener Planet. Coastal and Marine applications.Geological applications.
Conquest: A History of Space achievement from v1 to Skylab & Soyuz in 3 1hr videos with comprehensive NASA and Soviet footage.13.75ea (to buy)

Slides: (We have a large stock and can search for special requests)

This is only a representative selection:Please phone for detailed lists
******* Single book orders 1.00 P&P. All other orders 2.00 P&P.**********
VAT inc. where applicable

Access

RIG SHOP CORNER

Meteosat Downconvertor:-

a) Assembled and tested module in tin plate box:-
£129.69 + £1.50 p&p.

b) Complete mounted in weather proof box:-
£157.96 + £3.00 p&p.

Waterproof power and channel change connector £10.00 extra if required, but note these functions can all be done via the coaxial downlead.

RIG VHF Scanning Receiver

a) Basic receiver module, with LED Channel number display, fully assembled and tested
£112.55 + £1.50 p&p

b) Same module as above but with liquid crystal frequency display module replacing the LED Channel display.
£151.57 + £1.50 p&p

Cheques for above units payable to 'DARTCOM' please

Items below available from the secretary:
The **RIG VHF preamp** also available includes a bandpass filter and is ideal for mast-head mounting. It is available from the secretary as a built and aligned PCB measuring 85mm by 33mm (3 5/16 x 1 15/16 inches). Module including first class post £13.37

28 page booklet entitled: Introduction to Weather Satellites & their Reception by Mike Mansfield. £2.50

Parts for **Low noise Amplifier** - see RIG 18 £30.00
only 4 left, next batch available in Autumn
David Juett YU3 i/f s/w for IBM PC & clones £6.50

Cheques payable to "Remote Imaging Group" please

FRAMESTORE PCBS:
The 001 board of the YU3 framestore design is currently being extensively revised to include buffered 8 bit A-D outputs and ctrl signals, a new Sample & Hold chip, LED activity indicators on all 8 bits and the incorporation of external controls for the A-D chip. The boards are still not ready. Enquiries incl. sae to the secretary please, a reply will be sent when they are ready for sale.

GAREX ELECTRONICS

***** TIMESTEP WEATHER SATELLITE SYSTEMS *****

SPECTACULAR NEW ATARI *ANIMATED* SYSTEM Garex are proud to announce that they are the first appointed dealer for this incredible new Timestep product. Following on from Timestep's phenomenal success in the education market, a special low cost Atari ST version of their *animation* system is now available from stock. Simply plug in your existing receiver to view amazing pictures. For the ultimate add a Meteosat receiver for unbelievably smooth 14 frame *animation* that is completely automatic once set up. Just watch the clouds roll by ! New pictures are added twice an hour if required, the oldest being discarded automatically. This sophisticated package will run on any Atari ST1040 and compatible colour monitor. Complete with all software and colour-keyed Atari interface. This equipment is of such high quality that Atari UK exhibited it on their stand at Which Computer 1989 !
Interface and software, just connect your existing receiver. £345.00
Optional colour to 16 grey scale adaptor. £24.95
For those who would like a one-stop-shop, the complete package ready-to-run :
Meteosat Dish, Pre-Amp and Receiver, 43M cable, Atari Interface, Grey Scale Adaptor, 14" Colour Monitor, Atari ST1040, Software (including demonstration disc) and, of course all other cables and connectors. On your doorstep ~~£1,695.00~~ ***** Call for very special price !**

COMPACT FRAMESTORE SYSTEM The *BASIC* MICROWAVE METEOSAT system. For no complications a complete plug in and go package that requires no computer, no software, no extra monitor and can be up and running, including dish alignment within 10 minutes of receipt. 256 x 256 pixels and Timestep's digital 64 grey level output gives outstanding results. This is the system that the London Science Museum has chosen to display in the new Space and Exploration Gallery, for the next 12 years !. Stop press. Did you notice this equipment giving totally noise free pictures live at Sandown Park ?.
Nothing more to buy:
Meteosat Dish, Pre-Amp and Receiver, 43M cable, Framestore, 12" B/W Monitor and, of course all other cables and connectors. £995.95
Also available less monitor. ~~£885.00~~ ****** STOP PRESS call for very special price !**

AMIGA AMIGA AMIGA !! Available from stock now. Amazing 600x400 pixels in 16 shades of grey on a standard monitor. Animation of 13 frames. Runs on any A500 1Mb. Interface and software only £345.00. Use your existing receiver !.

IBM See the Timestep last issue advert for this systems to put all others in the shade.

SATELLITE ACCESSORIES

Meteosat receiver. Dish input and 2 watt audio output. £270.25
Meteosat Pre-amp. 15dB gain 0.6dB noise figure GaAs FET. £92.00
Meteosat dish, 0.9M with feed horn. £199.00
10M H100 fitted N connectors. £29.85
NOAA *BASIC* Turnstile antenna, ready wired phasing harness and a connector fitted, complete with mast bracket. £39.95
NOAA *BASIC* Pre-amp, 3 pole filtering, boxed and fitted with connectors, 14dB gain 1.0dB noise figure, for the Turnstile antenna. £24.95
NOAA cable, 50M high quality cable fitted with connectors. £24.95

ADD VAT at 15%
***** ACCESS & VISA WELCOME *****

GAREX ELECTRONICS
HARROW HOUSE AKEMAN STREET TRING HP23 6AA
Tel. Tring (044282) 8580 and Cheddington (0296) 668684
Callers by appointment.

FENWAY WEATHER SYSTEMS PRICES

Fenway Weather Systems are proud to be the distributor of the TIMESTEP-DIGITAR range of weather stations. Now for the first time, these beautifully made American instruments are available at sensible low cost prices.

TWR-3 A tiny, completely stand alone unit featuring :-
Wind speed. Wind direction. Wind chill factor. Wind gust record. Outside or inside temperature. High/low temperature record. Metric or imperial. 12/24 hour clock. Scan feature. Daily and yearly rainfall optional.
TWR-3 £99.50 RG-3 Rain collector £36.95

WD-2 A small completely stand alone unit featuring :-
Wind speed and alarm. Wind direction. Wind chill factor. Wind gust record. Outside temperature and alarm. Inside temperature and alarm. High/low temperature alarm. Metric or imperial. 12/24 hour clock. Programable scan feature. Daily and accumulated rain fall optional. Calendar. Illumination.
WD-2 £149.95 RG-2 Rain collector £36.95

PCW A unique, totally computer controlled weather station. Any standard PC type computer with XT or AT expansion slots can be used. Operating in a "background mode", this weather station will enable your PC to carry on working on your business software as normal. Data will be stored for recall later. Featuring :- Sea level barometric pressure. Wind speed and alarm. Wind direction. Wind chill factor. Wind gust record. Outside temperature and alarm. Inside temperature and alarm. High/low temperature store. All metric and imperial units. 12/24 hour on board clock. Daily and accumulated rainfall optional. PCW-PRO software optional.
PCW £199.95 RG-2 Rain collector £36.95

PCW-PRO Incredibly sophisticated automatic data logging software for the PCW. This software automatically plots each parameter in easy to understand 24 hour graphs. Identifying trends has never been easier !. Days, months and even years, may be automatically stored on disc for analysis in the future. For the advanced user a conversion program is included to produce ASCII files for database and spreadsheet applications. ASCII file dumps for other program use such as databases and spreadsheets. **PCW-PRO £59.95**

PCSAT+ Come and see this incredible weather satellite system running live. With the optional VGA600 card it will display 800 pixels, 600 lines and 256 colours simultaneously on the screen. Compare it side by side with the framestore and see the amazing 7 times better resolution in monochrome and 27 times improvement in colour. If you already have a Meteosat receiver the cost is just £399.00 for the Interface, Interface Card and software. VGA, Animate and NOAA/Meteor software available. The VGA600 card is available at £299.00.

VAT at 15%. Carriage extra. ACCESS, MASTERCARD and VISA welcome.

Fenway Weather Systems
Victoria Way Industria Estate Newmarket CB8 7SH England
Tel. 0638 665300 FAX. 0638 666555

TIMESTEP

For this issue we thought you might like to know a little more about Timestep. Questions that have been asked include :-

Who is Timestep ? Timestep and it's subsidiaries are wholly owned and managed by Dave Cawley. You may have seen and chatted with him at the Which Computer show, the Personal Computer show, the ASE exhibition or the BETT at the Barbican in the last year. Timestep was first registered in 1975 and made into a Limited Company in 1979.

Who works for Timestep ? Dave Cawley our Managing Director of course works full time in both the Marketing and Development department. Peter Arnold our new Cambridge University Graduate works full time writing software for our weather satellite products and for our commercial products. Brenda Smith and Peter Wright run the manufacturing facility. Barry looks after our warehousing and stock control.

Does Timestep have a factory ? Timestep share a new 3,500 square foot factory unit in Newmarket.

What equipment does Timestep use ? We have bought from new 2 Marconi Microprocessor controlled RF generators and an Anritsu 2GHz Spectrum Analyzer and matching Tracking Generator. We also have the latest Hewlett Packard Power Meter and a bewildering pile of other test equipment. For manufacturing we use a Flow Soldering Machine and a Vapour Phase cleaner. We really must stress that ALL this equipment is used solely for Timestep production, it is not shared, borrowed or moonlighted from other companies.

Are Timestep's products really their own ? Yes ! All our current products are designed here in Newmarket. Our Yagi for example was designed from first principals and needed no so called optimising ! We have return loss plots available for inspection. We do not import or buy hardware from any other manufacture at all. We own all Copyright and Intellectual Property Rights on all our Software and Hardware, except Instant Track, Satellites in the Classroom and Weather Forecaster. We licence some of our competitors to use our designs and circuits. This brings us in money to further enhance our continuing development.

Does Timestep have a full time outlet in the U.S.A. ? Yes. We use Fisher Scientific in Chicago. We will be appointing further distributors of our low cost system soon.

Who are Timestep's dealers in the UK ? Fenway, Garex, Griffin & George and ICS are our Master Dealers.

How good is PCSAT+ Ask our customers ! Seriously though, you really do have to see it to believe it. We support all known VGA cards now, right up to 800 pixels x 600 lines x 256 colours all on the screen at the same time. The new Amstrad and Atari PC's have a little known mode of 640 pixels x 400 lines x 256 colours as standard, of course we fully support this low cost high resolution mode. On all systems we always offer zoom to pixel level regardless of the video card in use. We also store ***full satellite resolution*** as you would expect.

What are the latest products ? We have no less than 4 new products. The first is our VGA **NOAA software** that will automatically receive NOAA in your absence on any system with PCSAT+. It has many modes including scrolling. Full contrast stretch and equalisation is available. It also receives all current Meteor satellites as well, in up to 800 pixels x 600 lines x 256 colours ! The second product is **Instant Track**. This is a definitive SATFOOT clone that will work on any IBM clone. It shows the world, the satellites and every possible thing you would want to know about satellites. For RIG members only, we can supply at £19.95 including VAT and postage. The third product is the book **Weather Satellites in the Classroom** written by James Hinderson, Humanities Advisor for the Field Studies Council. This 190 page photocopyable resource is a must for all teachers. For RIG members only, it is available for £34.95 including VAT and postage. The fourth product is an IBM program **The Weather Forecaster** that will forecast local weather conditions for 24 hours. Impossible ? using a Neural Network Expert System and locally collected temperature and pressure.
It incorporates a Self Teaching technique to adapt to your local situation. For RIG members only, this IBM PC package is £49.99 including VAT and postage. Send now for your free catalogue.

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